TM 11–6625–2781–14–6

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST FOR

FILTER, VARIABLE F–1414/U(HP–8445B)

(NSN 6625-00-253-4833)

HEADQUARTERS, DEPARTMENT OF THE ARMY

30 NOVEMBER 1978

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

DON'T TAKE CHANCES!

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NO. 11–6625-2781-14-6

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *30 November 1978*

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In either case a reply will be furnished direct to you.

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. The manual was not prepared in accordance with military specifications; therefore, the format has not been structured to consider categories of maintenance.

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This manual supersedes TM 11-6625-2865-14&P, 26 January 1978.

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SECTION 0

INTRODUCTION

0-1. Scope

This manual contains instructions for the operation, organizational maintenance, and general support maintenance of Filter, Variable F-1414/U hereinafter referred to as Hewlett-Packard Model HP-8445B Automatic Preselector.

NOTES

Appendix C contains a list of applicable references, Appendix D contains the maintenance allocation chart (MAC).
No direct support maintenance is authorized for this equipment.

0-2. Indexes of Publications

a. DA Pam 310-4. Refer to latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO'S) pertaining to the equipment.

0-3. Forms and Records

a. Reports of Maintenance of Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DLAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33 B/AFR 75-18/MCO P4610.19C, and DLAR 4500.15.

0-4. Administrative Storage

Before placing the F-1414/U in temporary storage (90 days), determine the serviceability of the equipment by performing the maintenance procedures described in paragraphs 8-32 and 8-34.

0-5. Destruction of Army Electronics Materiel.

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

0-6. Reporting Equipment Improvement Recommendations (EIR)

EIR's will be prepared using Standard Form 368, Quality Deficiency Report. Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

0-7. Items Comprising an Operable Equipment

Filter, Variable F-1414/U comprises an operable equipment.

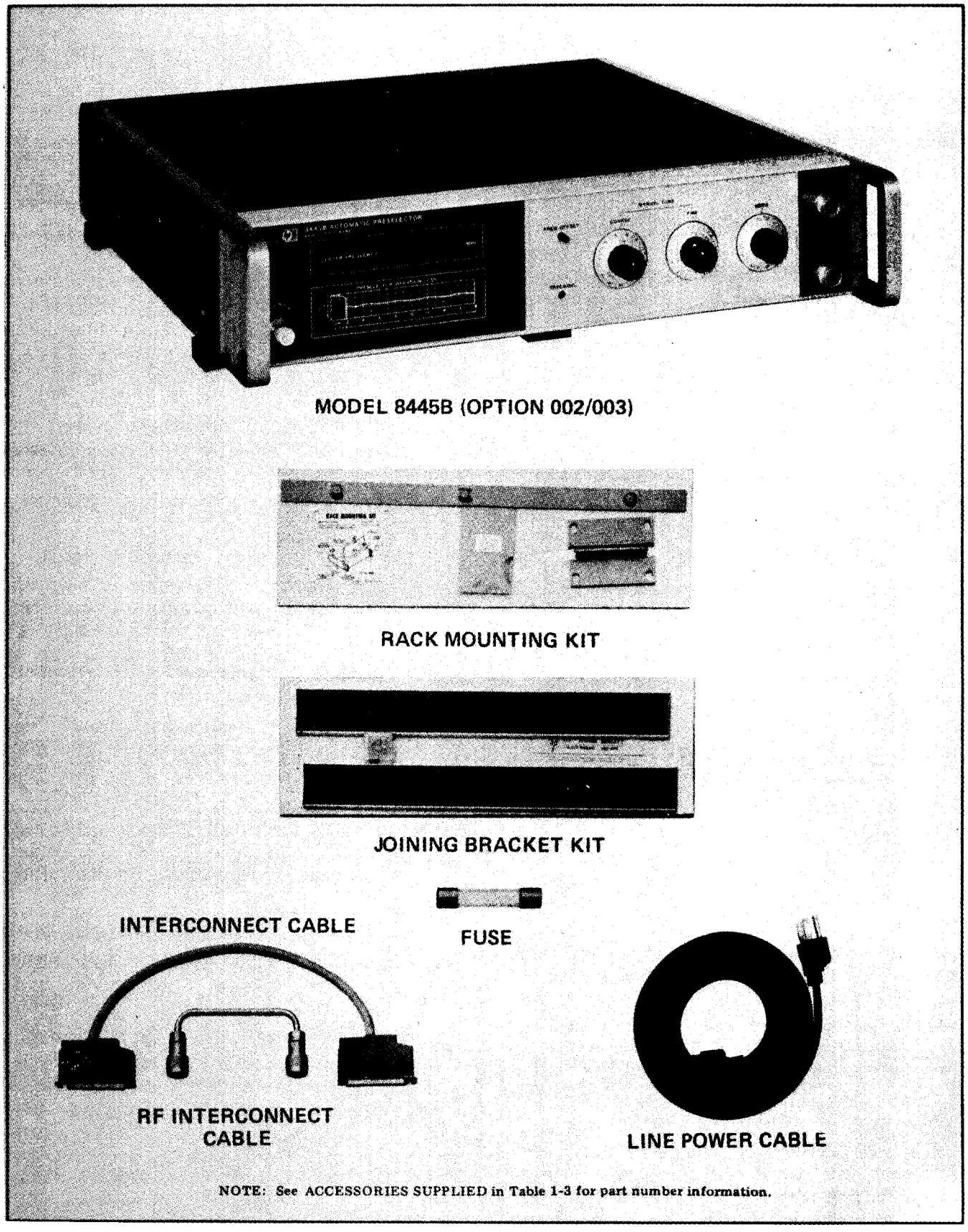


Figure 1-1. Mode1 8445B and Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 8445B Automatic Preselector. This section covers instrument identification, description, options, accessories, specifications and other basic information.

1-3. Figure 1-1 shows the Hewlett-Packard Model 8445B Automatic Preselector with Option 002 (manual tuning controls) and Option 003 (digital readout of center frequency).

1-4. The various sections in this manual provide information as follows:

SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, mounting, packing and shipping, etc.

SECTION III, OPERATION, provides information relative to operating the instrument.

SECTION IV, PERFORMANCE TESTS, provides information required to ascertain that instrument is performing in accordance with published specifications.

SECTION V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs are made.

SECTION VI, REPLACEABLE PARTS, provides ordering information for all replaceable parts and assemblies.

SECTION VII, MANUAL CHANGES, normalIy will contain no relevant information in the original issue of a manual. This section is reserved to provide back-dated and up-dated information in manual revisions or reprints.

SECTION VIII, SERVICE, includes all information required to service the instrument

1-5. Supplied with this manual is an Operating Information Supplement. The Supplement is a copy of the first three sections of the manual, and should be kept with the instrument for use by the operator. Also included with the manual is an Overall Schematic Diagram. Additional copies of both the Operating Information Supplement and the Overall Schematic Diagram can be ordered separately through your nearest Hewlett-Packard office. The part numbers are listed on the title page of this manual.

1-6. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4 x 6-inch microfilm transparencies contains up to 60 photoduplicates of the manual pages. The Microfiche package also includes the latest Manual Changes supplement and all pertinent Service Notes.

1-7. SPECIFICATIONS

1-8. Specifications for the instrument are listed in Table 1-1. These are the performance standards the instrument is tested against. A list of typical operating characteristics is provided in Table 1-2. They are included as additional information only; they are not specifications.

1-9. SAFETY CONSIDERATIONS

1-10. General

1-11. This is an International Electrotechnical Commission (IEC) Safety Class I instrument, designed and tested according to IEC Publication 348, “Safety Requirements for Electronic Measuring Apparatus.” It has been supplied in safe conditon.

1-12. Operation

1-13. BEFORE APPLYING POWER, make sure the ac input to the instrument is set for the available ac line voltage, that the correct fuse is installed (Figure 2-1), and that all normal safety precautions have been taken.

1-14. Service

1-15. Although the instrument has been designed in accordance with international safety standards,

Table 1-1. 8445B Specifications

SPECIFICATIONS

Frequency Range: Dc to 1.8 GHz Low-Pass Filter.
1.8 to 18 GHz Tracking Filter.

Digital Frequency Readout (Option 003):

Resolution: 1 MHZ
Accuracy: 0.01 to 1.0 GHz: ±6 MHz
1.0 to 4.0 GHz: ±8 MHz
4.0 to 18.0 GHz: ±0.2 %

Out-of- Band Rejection: For YIG tuned filterl GHz from center of passband >70 dB.

Limiting Level: > +5 dBm (Maximum input level for < 1 dB signal compression).

Burnout Level: > +20 dBm.

Hysteresis: < 25 MHz.

Tuning Linearity: < ±10 MHz.

Insertion Loss:

	Frequency	Insertion Loss (except Option 004)	Insertion Loss Option 004
Low-Pass Filter	Dc — 1.8 GHz @ 2.05 GHz	< 2.5 dB > 50 dB	*
Tracking Filter (YIG)	1.8 — 12 GHz 12 — 18 GHz	< 8 dB < 10 dB	< 7 dB < 8 dB

*Low-Pass Filter deleted with Option 004.

Table 1-2. Typical Operating Characteristics

TYPICAL OPERATING CHARACTERISTICS

Tracking Filter 3 dB Bandwidth: Typically 20-45 MHz.

Tracking Filter Skirt Roll-off: Characteristics of a three-pole filter.

Input VSWR: Typically < 2.0 (1.8 — 18 GHz).

8555A Local Oscillator Emission with Preselector: Typically < —70 dBm over recommended operating ranges with Spectrum Analyzer input attenuator set to 0 dB. (See Table 3-1.)

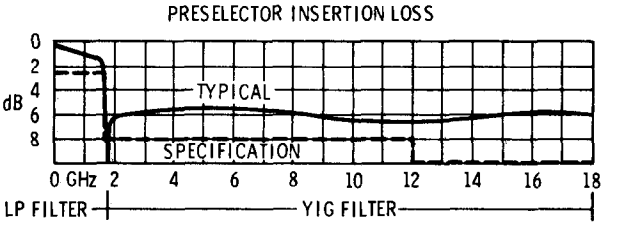
Remote Function: YIG filter frequency can be set by externally supplied voltage. Differential input utilized to eliminate ac hum or other common mode signals which may be present on remote drive input cable.

Sensitivity: Nominally +1 volt/GHz (with direction of tuning from low to high frequency).

Settling Time: Typically within 3 MHz of final frequency after 5ms.

Remote Input Connector: BNC female, outer conductor isolated.

Typical Insertion Loss: The following chart shows typical versus specification values of insertion loss. (The typical curve is developed from eleven spot checks. See paragraph 5-15.)



the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. Service and adjustments should be performed only by qualified service personnel.

1-16. Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when inevitable, should be performed only by a skilled person who knows the hazard involved.

1-17. Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short circuit the fuse holders.

1-18. Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

WARNING

If this instrument is to be energized through an autotransformer (for line voltage variation), make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with protective earth contct. The protection must not be negated by using an extension cord (power cable) without a protective grounding conductor.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument's ac input is set to the voltage of the ac power source.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure that all devices connected to the instrument are connected to the protective earth ground.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the ac line fuse is of the required current rating and type (normal-blow, slow-blow, etc.)

1-19. INSTRUMENTS COVERED BY MANUAL

1-20. Attached to the instrument is a serial number plate (Figure 1-2). The serial number is in two parts. The first four digits and the letter are the serial number prefix; the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-21. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" which tells you how to adapt the manual to the newer instrument.

1-22. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-23. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

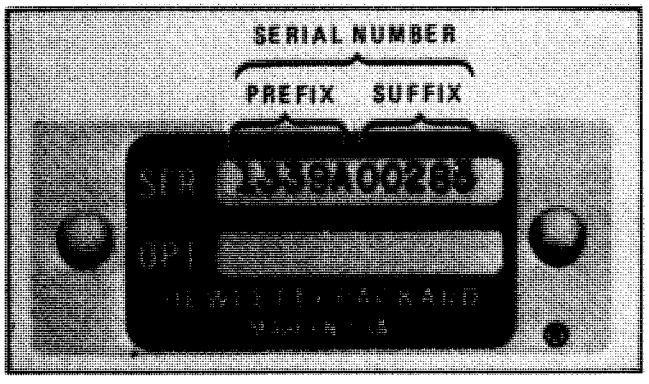


Figure 1-2. Serial Number Plate

1-24. Option 003 Instruments Only

1-25. When an 8445B, Option 003 instrument is ordered (see paragraph 1-33), this manual, an Option 003 Supplement, and an A7 Digital Panel Meter (HP Model 34740A) manual are shipped with the instrument.

1-26. This manual provides necessary references to either the supplement or the A7 DPM Assembly (34740A) manual. The supplement includes partial schematics, tables, and explanations of interconnections and/or modifications made to the Digital Panel Meter which make it compatible to the 8445B.

1-27. DESCRIPTION

1-28. The Model 8445B Automatic Tracking Preselector is designed to complement the Model 8555A Spectrum Analyzer RF Section. The Standard Preselector covers the frequency range of dc to 18 GHz. When used with the 8555A Spectrum Analyzer, the Preselector functions to reduce or eliminate signal intermodulation, in addition to multiple and spurious responses. The Standard Preselector has a fixed frequency low-pass filter for the dc to 1.8 GHz frequency range, and a voltage tuned filter, using a YIG (yttrium-iron-garnet) crystal as a resonant tuning circuit in the RF signal path for the frequency range of 1.8 to 18 GHz. When used with the 8555A/8552/140 Spectrum Analyzer system, the YIG filter is a swept selective filter that tracks the frequency of the analyzer as the analyzer sweeps across its selected range. The YIG filter is electronically tuned by sweep voltage and band code signals from the analyzer. In addition to its primary function as a Preselector, the YIG filter may be used as a manually or electronically tuned bandpass filter. The YIG filter maybe tuned by external sweep voltage or manually tuned by front panel controls (Option 002). A Digital Panel Meter (Option 003) normally indicates the Spectrum Analyzer center frequency. In remote or manual modes, the indicated frequency is that to which the YIG filter is tuned.

1-29. OPTIONS

1-30. The Standard 8445B. An Automatic Preselector consisting of a YIG-tuned tracking filter operating between 1.8 and 18 GHz, and a dc to 1.8 GHz low-pass filter. The input and output ports of the instrument are Type N coaxial connectors. Included is an HP 11670L rigid coaxial cable for connection of the 8445B output to an 8555A spectrum analyzer when the preselector is mounted above the 8555A with a joining bracket kit. For other mounting configurations, order 8445B Option 005 to delete the 11670L. Then select the appropriate cable indicated in Table 1-4.

1-31. Option 001. The standard Type N input and output port connectors are replaced by Precision APC-7 connectors. An HP 11670M interconnect cable (with APC-7 connectors) is included in place of the HP Number 11670L cable. An 8445B Option 001 must be used with an 8555A Option 001 which has an APC-7 RF Input connector. (An APC-7 terminated RF interconnect cable can be ordered from Table 1-4. Order Option 005 to delete the standard Type N interconnect cable.)

1-32. Option 002. A front panel MODE switch and two MANUAL TUNE controls are added to the Automatic Preselector to provide selection of manual tuning, automatic tuning, and remote tuning of the YIG-tuned filter, or substitution of a 1.8 MHz low-pass input filter.

1-33. Option 003. A digital readout of the center frequency of the spectrum analyzer is displayed by a digital panel meter (DPM) on the front panel of the preselector. The DPM indictes the frequency of the YIG-tuned filter when voltage fed to the REMOTE input BNC connector is used to control the YIG.

1-34. Option 004. The 1.8 GHz low-pass filter is deleted.

1-35. Option 005. The HP 11670L rigid RF Interconnect cable is deleted.

1-36. Option 100. Includes a modification kit for certain Model 140 mainframes (see Paragraph 2-22 and Table 2-2) to make these displays compatible

with the 8445B. It adds an Auxiliary B output jack to the display mainframe.

1-37. Option 200. Includes a modification kit for certain Model 140 mainframes (see Paragraph 2-22 and Table 2-2) to make these displays compatible with the 8445B. It adds Auxiliary A and B output jacks to the display mainframe.

1-38. ACCESSORIES SUPPLIED

1-39. Table 1-3 lists the accessories supplied with the Preselector. The accessories supplied are for a standard installation which provides for the Preselector to be mounted on an 8555A Spectrum Analyzer and fastened with a joining racket kit. A different mounting installation will require a different RF cable to connect between the Preselector output and the Spectrum Analyzer input (Figure 1-3). The power cable supplied with the instrument is selected at time of shipment. Selection is based on shipping destination. Figure 2-2 illustrates the different power cable connectors that are currently available.

1-40. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-41. The Automatic Preselector is intended for use with the 8555A Spectrum Analyzer System. This includes an 8555A RF Section, an 8552 series IF Section, and a 140 or 141 series Display Section.

1-42. EQUIPMENT AVAILABLE

1-43. The rigid RF Interconnect cable used to couple a Preselector to a Spectrum Analyzer is illustrated in Figure 1-3. Standard Preselectors are made to operate above the Spectrum Analyzer. The possible mounting configurations, connector types, dimensions and part numbers are indicated in Table 1-4. For information regarding RF Interconnect cables used when the Preselector is mounted BELOW the Spectrum Analyzer, contact your local Hewlett-Packard Sales Office. A Rack Mounting Kit is available to install the instrument In a 19-inch rack. Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8739.

Table 1-3. Accessories Supplied

HP Part Number	Name	Description
*	Line Power Cable	7- 1/2 feet, 3-wire Ac, Line Cord
11670L**	RF Interconnect Cable	Rigid Coaxial Cable. Connects Preselector RF output to Spectrum Analyzer RF Input. Type N connectors.
08445-60007	Interconnect Cable	20-inch Control Cable, interconnects Preselector with Spectrum Analyzer.
2110-0012	Fuse	0.5A - 220/240 Vac
5060-8543	Joining Bracket Kit	Hardware and parts for strapping Preselector to Spectrum Analyzer.

***See paragraph 2-10 end Figure 2-2.**
****See paragraph 1-35 and Figure 1-3; item not supplied with Option 005.**

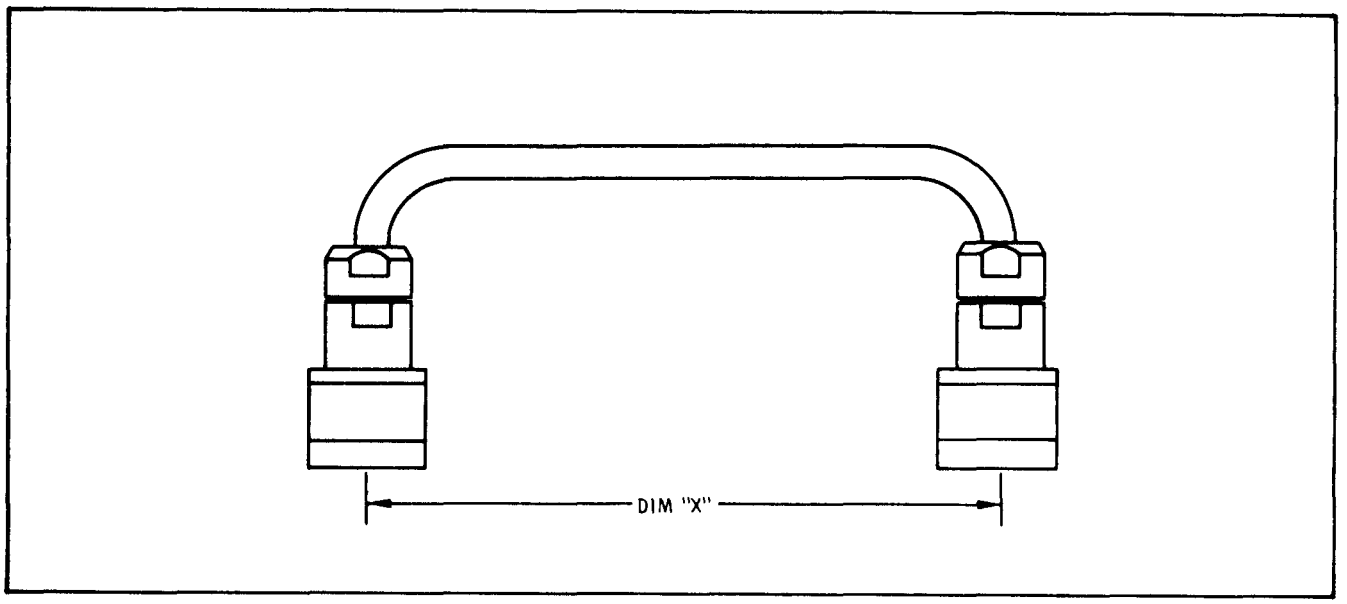


Figure 1-3. RF Interconnect Cable

Table 1-4. RF Interconnect Cable Information

Preselector Analyzer	Connector Type	Dimension of "X", Figure 1-3		HP Part Number
		Inches	Cm	
With feet on Preselector	N	4.72	11.99	11670C
With feet on Preselector	APC-7	4.72	11.99	11670D
Rack Mounted	N	4.58	11.63	11670G
Rack Mounted	APC-7	4.58	11.63	11670H
With Joining Bracket Kit	N	4.36	11.07	11670L*
With Joining Bracket Kit	APC-7	4.36	11.07	11670M**

***Cable supplied with kit - except when Option 005 ordered.**
****Cable supplied with Option 001 instruments.**

1-44. WARRANTY

1-45. The 8445B Automatic Preselector is warranted and certified as indicated on the inner front cover of this manual and in Appendix A. For further information, contact the nearest Hewlett-Packard office addresses are provided on the last page and office; addresses are provided on the last page and rear cover of this manual.

1-46. RECOMMENDED TEST EQUIPMENT

1-47. Table 1-5 lists the test equipment and accesseries required to check, adjust and repair the Preselector. If substitute equipment is used it must meet the Minimum Specifications listed.

Table 1-5. Test Equipment and Accessories (1 of 2)

Item	Minumum Specifications	Suggested Model	Use*
Frequency Comb Generator	Frequency markers spaced 1, 10, 100 MHz apart; usable to 8 GHz Frequency Accuracy: ±0.01% Output Amplitude: > −40 dBm to 2 GHz	HP 8406A Comb Generator	A,T
Signal Generator	Frequency Range: 1.8 — 4.0 GHz Frequency Accuracy: ±1% Output Amplitude: > +5 dBm Output Impedance: 50 ohms	HP 8616A Signal Generator	P,A
Sweep Oscillator	Frequency Range: 2.0 — 18 GHz Output Amplitude: > −5 dBm Output Impedance: 50 ohms	HP 8620A Sweep Oscillator with 86290A RF Unit	P,A
Digital Voltmeter	Voltage Accuracy: ±0.01% of reading +0.01% of range Resolution: ±1 mV @ 10 volts Overrange: 50% Input Impedance: 10 megohms	HP 3480B Digital Multimeter with HP 3484A Multi-Function Unit	A,T
Oscilloscope	Frequency Range: DC to 50 MHz Time Base: 1 μs/div to 10 ms/div Time Base Accuracy: ±3% Dual Channel, Alternate Operation Ac or dc Coupling External Sweep Mode Voltage Accuracy: ±3% Sensitivity: 0.005 V/div	HP 180A with HP 1801A Vertical Amplifier and HP 1821A Horizontal Amplifier HP 10004 10:1 Divider Probes (2)	T
Power Meter	Frequency Range: 0.01 — 18.0 GHz Accuracy: ±1% Power Range: −20 to +10 dBm	HP 435A Power Meter with HP 8481A Power Sensor	P
Power Supply Dual Dc	Output Voltage: Variable, 0 — 20 Vdc Output Current: 0 — 300 mA Meter Accuracy: 3% Control: Fine adjustment	HP 6205B Power Supply	P,A,T
Dc Volt-ohm-Ammeter	Voltmeter Voltage Range: 1 mV — 300 V Accuracy: ±1% Input Resistance: 10 megohms Ammeter Current Range: 1 μA — 1A Accuracy: ±2% Ohmmeter Resistance range: 1 ohm — 100 megohm Accuracy: ±5% reading at center scale	HP 412A Volt-Ohm-Ammeter	T

*A = Adjustments; T = Troubleshooting; P = Performance

Table 1-5. Test Equipment and Accessories (2 of 2)

Item	Minumum Specifications	Suggested Model	Use*
Spectrum Analyzer	Frequency Range: 0.01 — 18 GHz Frequency Response: < ±2.0 dB	HP 8555A Spectrum Analyzer with HP 8552 IF Section and HP 141T Display Section	P, A, T
AC Voltmeter	Voltage Accuracy: ±2% of full scale Voltage Range: 300 Vac full scale Input Impedance: 10 megohms	HP 427A Multifunction Voltmeter	A
Variable Voltage Transformer	Voltage Range: 102 — 127 Vac	General Radio W5MT3A or Superior Electric UC1M	A
Coaxial Cable	Male BNC Connectors, 44 inches long with alligator clips	HP 10501A Cable Assy w/alligator clips	P,A
Frequency Meter	Frequency Range: 2 — 18 GHz Overall Accuracy: 0.2%	HP 536A/537A/P532A Frequency Meters	A
Swept Frequency Indicator	Sensitivity: 5 dB/div Blanking: 0 — 5 V gate Vertical Input Impedance: 75K ohms	HP 8755A Swept Amplitude Analyzer 180D, Option 807 Display, 11664A Detector 11665A Modulator	A
6 dB Coaxial Attenuator	Frequency Range: Dc — 18 GHz	HP 8491B Coaxial Attenuator, Option 006	A
10 dB Coaxial Attenuator	Frequency Range: Dc — 18 GHz	HP 8491B Coaxial Attenuator, Option 010	A
Adapter	APC-7 to Type N male	HP 11525A	A
Clip-on Milliammeter	Dc Current Range 1mA — 10A Accuracy ±3% of full scale	HP 428B	T

*A = Adjustments; T = Troubleshooting; P = Performance

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section includes information on the initial inspection, preparation for use, and storage/ shipment instructions for the HP Model 8445B.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The Model 8445B requires a power source of 100, 120, 220, or 240 Vac +5% -10%, 48 to 440 Hz single phase. (440 Hz operation requires a special H16 440-Hz fan modification. Contact your nearest HP representative.) Power consumption is less than 110 volt-amperes.

2-8. Line Voltage and Fuse Selection

2-9. Select the line voltage and fuse as follows:

a. Measure the ac line voltage and fuse as follows:

b. Refer to Figure 2-1. At the instrument's rear panel power line module, select the

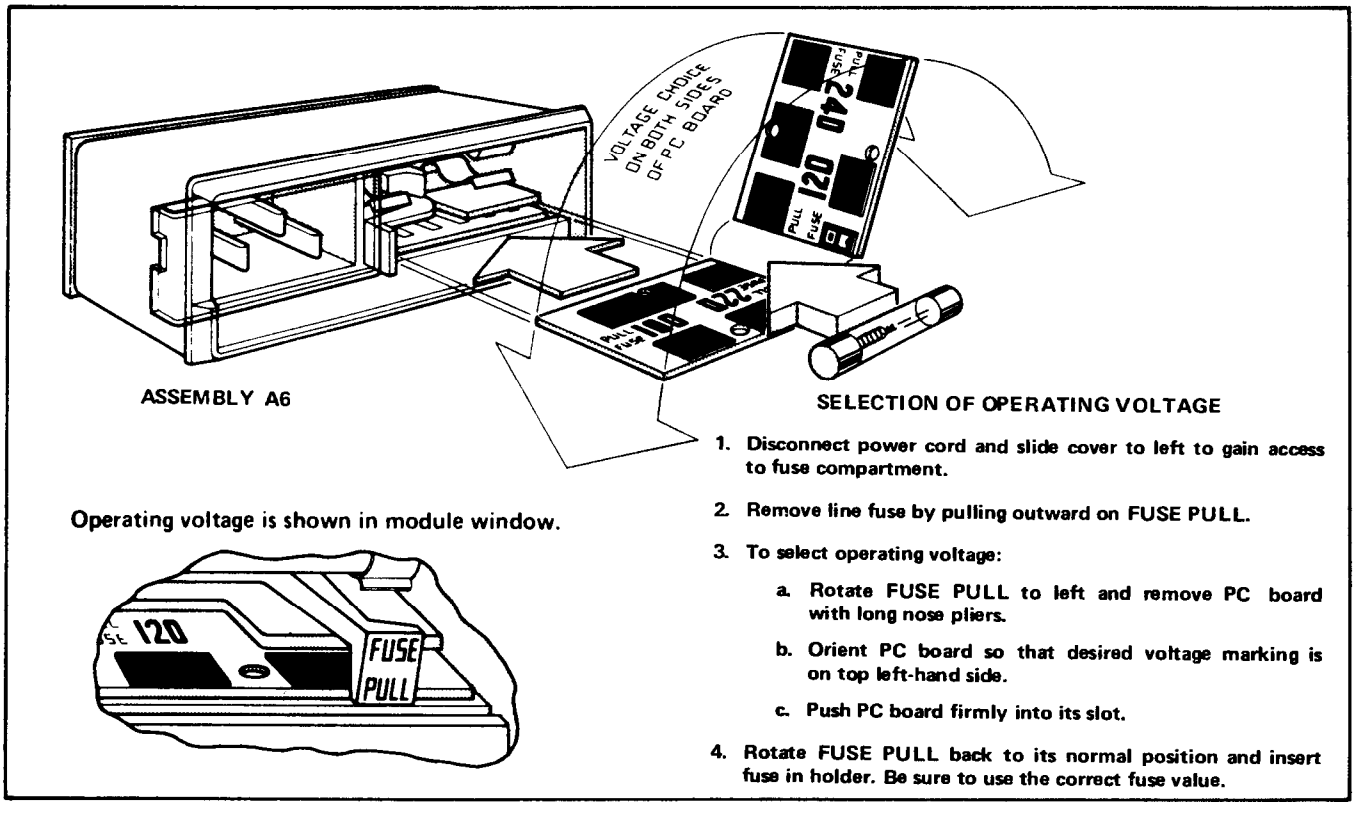

VOLTAGE CHOICE ON BOTH SIDES OF PC BOARD
240
120
PULL
FUSE
ASSEMBLY A6
SELECTION OF OPERATING VOLTAGE
1. Disconnect power cord and slide cover to left to gain access to fuse compartment.
2. Remove line fuse by pulling outward on FUSE PULL.
3. To select operating voltage:
a. Rotate FUSE PULL to left and remove PC board with long nose pliers.
b. Orient PC board so that desired voltage marking is on top left-hand side.
c. Push PC board firmly into its slot.
4. Rotate FUSE PULL back to its normal position and insert fuse in holder. Be sure to use the correct fuse value.
Operating voltage is shown in module window.
120
FUSE
PULL

Figure 2-1. Line Voltage Selection

line voltage (100 V, 120 V, 220 V, or 240 V) closest to the voltage you measured in step a. Line voltage must be within +5% or -10% of the voltage setting.

c. Make sure the correct fuse is installed in the fuse holder. The required fuse rating for each line voltage selection is indicated at the power module.

d. Connect the ac power cord to the instrument ac power receptacle.

2-10. Power Cable

2-11. In accordance with international safety standards this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Figure 2-2 shows the styles of mains plugs available on power cables supplied with HP instruments. The numbers under the plugs are part numbers for complete power cables.

WARNING

The protection provided by grounding the instrument cabinet may be lost if any power cable other than the 3-pronged type is used to couple the ac line voltage to the instrument.

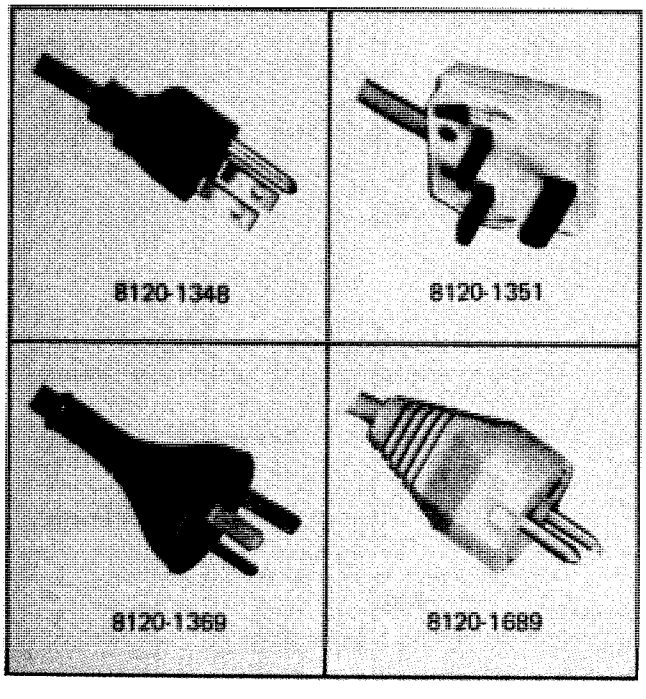


Figure 2-2. Power Cable HP Part Numbers Versus Mains Plugs Available

2-12. Mating Connectors

2-13. A list of possible connectors on the front and rear panels of the Model 8445B is given in Table 2-1.

2-14. Operating Environment

2-15. The operating environment should be within the following limitations:

Temperature . . . . . .0 to 55° C
Humidity. . . . . <95% relative
Altitude . . . . . .<15,000 feet

2-16. A forced-air cooling system is used to maintain required operating temperatures within the instrument. The air intake and filter are located on the rear of the instrument; warm air is exhausted through the side panel perforations. When operating the instrument, choose a location which provides at least three inches of clearance around the rear and sides.

2-17. Installation Instructions

2-18. When used with the Spectrum Analyzer, the Preselector should be both mechanically and electrically connected to the Spectrum Analyzer. The preferred mounting configuration is with the Preselector mounted on top of and secured to the Spectrum Analyzer. A joining bracket kit is supplied to secure the Preselector to the analyzer. A rigid coaxial cable (for the preferred mounting configuration) is supplied to connect the OUTPUT on the Preselector to the INPUT connector of the Spectrum Analyzer. For mounting installations other than the preferred configuration refer to Figure 1-3 for cable information.

2-19. Bench Operation

2-20. The instrument cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel, and the plastic feet are shaped to make full-width modular instruments self-aligning when stacked.

2-21. Rack Mounting

2-22. This instrument is supplied with a rack mounting kit. This rack mounting kit contains all the necessary hardware and installation instructions for preparing the instrument to be mounted on a rack of 19-inch spacing. Installation instructions are given in Figure 2-3.

Table 2-1. Model 8445B Mating Connectors

Connector	Industry Identification	HP Part No.	Alternate Sources
J1 INPUT	Type N, male connector, UG-21G/U	1250-0882	Amphenol Bendix Specialty Connector
	(Option 001) Type APC-7 connector	1250-1183	Amphenol
J2 OUTPUT	Type N, male connector, UG-21G/U	1250-088	Amphenol Bendix Specialty Connector
	(Option 001) Type APC-7 connector	1250-1183	Amphenol
J4 REMOTE input	Type BNC, male connector, UG-88/U	1250-0256	Amphenol Bendix Specialty Connector
J5 Interconnect cable connector	R & P Series, 17 contact, female connector	1250-1286	Cannon Cinch

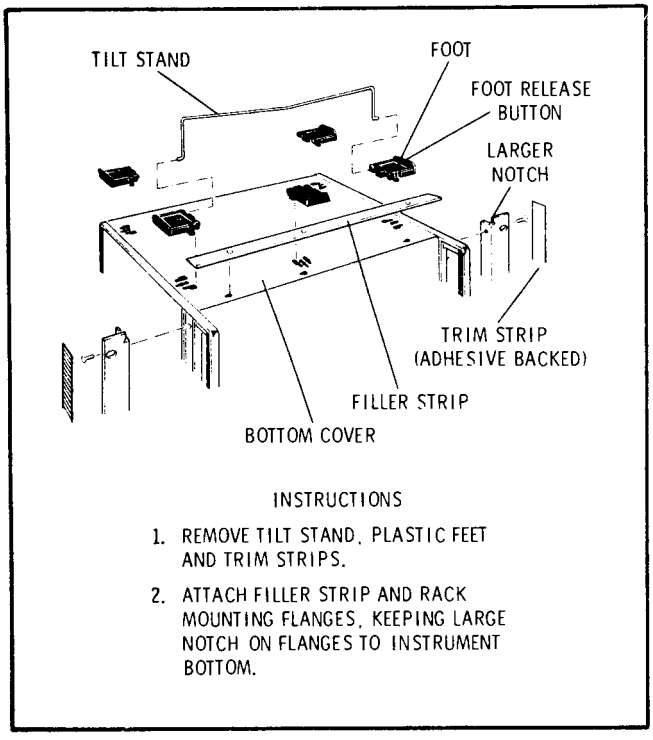

TILT STAND
FOOT
FOOT RELEASE BUTTON
LARGER NOTCH
TRIM STRIP (ADHESIVE BACKED)
FILLER STRIP
BOTTOM COVER
INSTRUCTIONS
1. REMOVE TILT STAND, PLASTIC FEET AND TRIM STRIPS.
2. ATTACH FILLER STRIP AND RACK MOUNTING FLANGES, KEEPING LARGE NOTCH ON FLANGES TO INSTRUMENT BOTTOM.

Figure 2-3. Preparation for Rack Mounting

2-23. MODIFICATIONS REQUIRED

2-24. Display Sections

2-25. HP Model 140T Display Sections with serial prefix 1105A and below, HP Model 141T Display Sections with serial prefix 1047A and below, all HP Model 140S/141S Display Sections and all HP Model 140-series Oscilloscope Mainframes require modification for Preselector compatibility (Refer to Table 2-2.) The modification consists of adding a cable assembly to the Display Section. This cable connects between the Auxiliary "B" output connector on the rear panel of the 8555A RF Section and the rear panel of the Display Section.

2-26. 8555A RF Section

2-27. Spectrum Analyzer RF Sections with Serial Prefixes 1232A and below must be modified per Service Note 8555A-1 for compatibility with 8445B Option 003 instruments. (See Appendix B.)

2-28. STORAGE AND

2-29. Environment

2-30. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature . . . . . -40 to +75°C
Humidity. . . . . <95% relative
Altitude . . . . . .<25,000 feet

2-31. Packaging

2-32. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-33. Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequte.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. 'Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

Table 2-2. Modification of Display Sections for Preselector Compatibility

Modification Kit HP Part Number	DISPLAY SECTION	
	HP Model Number	Serial Prefix
00140-69505	140T	1105A and below
	141T	1047A and below
	140S/141S (Option TG-1)	All
00140-6950	140S/141S (Except Option TG-1 Instruments)	All

*Included with 8445B Option 001.
**Included with 8445B Option 002.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section describes the HP 8445B Automatic Preselector operation with an HP 8555A/8552/140 Spectrum Analyzer system. It describes front and rear panel controls and connectors, and outlines operation of the system.

3-3. SPECTRUM ANALYZER PRESELECTION

3-4. The 8555A Spectrum Analyzer RF Section has a 2.01-4.4 GHz YIG-tuned first local oscillator (LO), and selects either a 550 or 2050 MHz first IF, depending on the frequency band in use. The untuned input circuitry of the 8555A accepts any signals from 10 MHz to over 18 GHz. These signals are mixed with the first LO as well as with harmonics of the LO. In some cases this presents problems interpreting several signals being displayed. The preselector is used to eliminate unwanted responses on the CRT display. The standard Preselector uses a low-pass filter for the frequency range of dc to 1.8 GHz, and a YIG resonator as a nominal 30 MHz bandwidth tunable microwave filter capable of operating over the frequency range of 1.8-18 GHz. The driving voltage used to tune the YIG first LO in the 8555A is modified and used to tune the YIG filter in the Preselector. By tracking the Preselector with the Spectrum Analyzer tuning, virtually all image, multiple, and spurious responses can be eliminated from the display.

CAUTION

Installation of a coaxial attenuator or a coaxial isolator at the Preselector INPUT is recommended when operating with signal sources that are not capable of absorbing their own reflected power. Any signals outside the passband of the Preselector input will be reflected back to the source.

3-5. Multiple responses occur when the local oscillator harmonics cause more than one display for a single input frequency. For example, when a 9.5 GHz signal is fed to the analyzer RF INPUT, responses due to the 5^{-}, 3^{+}, 4^{-}, 2^{+}, and 3^{-} appear on the display (see Figure 3-1). Follow the signal frequency line for 9.5 GHz across the figure noting the intersections with solid lines representing mixing modes. The Preselector tracks the selected mixing mode so that responses from other mixing modes are not present on the display.

3-6. When the analyzer first LO is tuned to 3 GHz (2050 MHz 1st IF), image responses may occur at different frequencies. (Refer to Figure 3-1.) Following the 3 GHz local oscillator line up the figure, note intersections with solid lines representing mixing modes. Each of these signals will appear at the same place on the CRT, although products of different mixing modes. The Preselector eliminates images by allowing only selected frequency band signals to enter the analyzer's RF INPUT, and allowing only one mixing mode to be used at one time.

3-7. Spurious signal responses are caused when strong signals enter the RF INPUT of the analyzer, and are of sufficient amplitude to cause intermodulation products. The narrow bandwidth of the Preselector YIG filter (30 MHz nominal) acts to eliminate spurious signal responses on the display. Input signals that are farther apart than the Preselector filter bandwidth cannot appear in the analyzer input at the same time.

3-8. RECOMMENDED MIXING MODES

3-9. Table 3-1 lists the frequency ranges that the Preselector will track when operating with an 8555A Spectrum Analyzer. It indicates signal frequencies from 0.01-18 GHz and the recommended 8555A frequency bands to be used for them. Analyzer responses, tracked by the Preselector, overlap at the edges of different frequency bands. Note the intersection of then =3- tuning curves at 4.1 GHz in Figure 3-1. Signals near the intersection points can appear in the passband of the Preselector from both of these mixing modes.

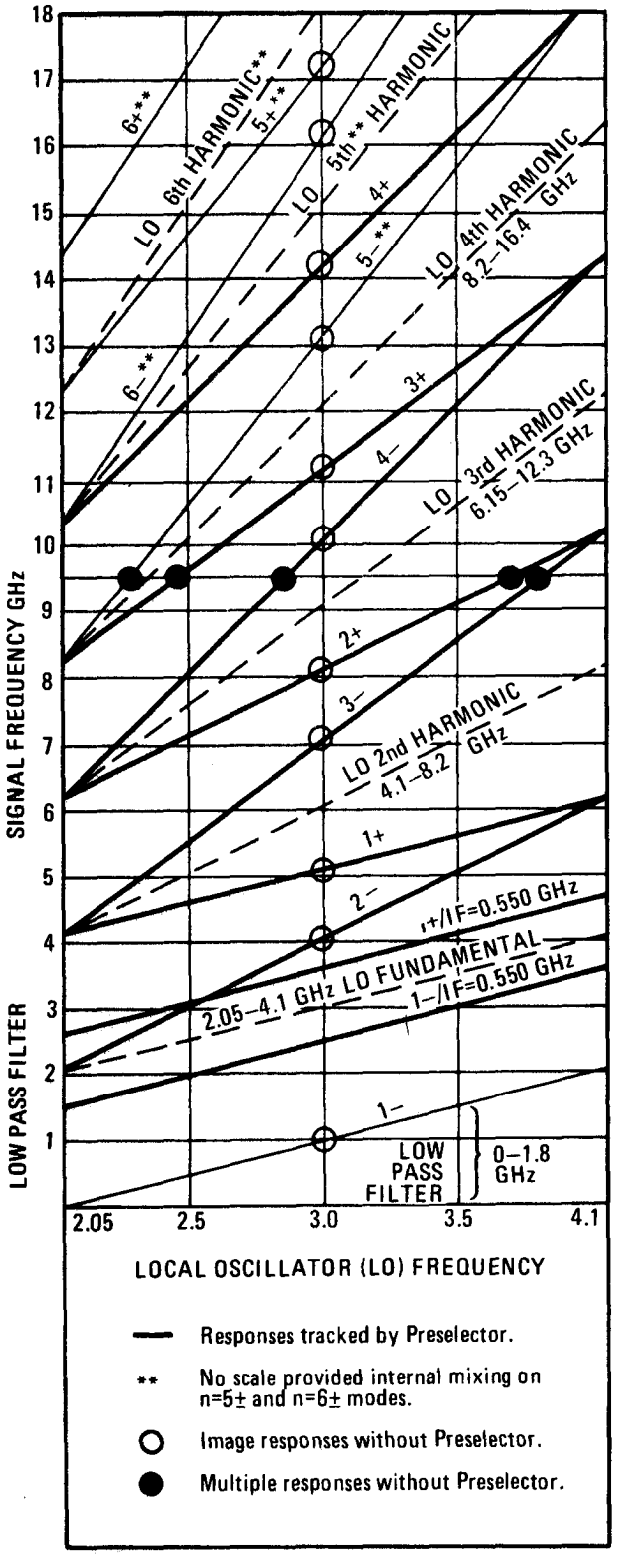


Figure 3-1. Spectrum Analyzer Tuning Curves and Responses

3-10. PRESELECTOR TRACKING

3-11. The Preselector tracking with the Spectrum Analyzer is governed by the linearity of the 8555A's YIG Drive sweep voltage versus the first LO frequency. Preselector tracking in both REMOTE and MANUAL operating modes is affected by the front panel FREQ OFFSET and TRACKING controls. Adjustment of these controls changes the accuracy of the + 1 V/GHz remote tuning and the dial accuracy of the manual controls. To adjust FRE Q OFFSET and TRACKING controls for correct REMOTE or MANUAL operation, perform the YIG DRIVER ADJUSTMENTS in Section V of this manual.

3-12. PRESELECTOR BANDWIDTH

3-13. The YIG filter has a 3 dB bandwidth that is typically 20 to 45 MHz depending on the portion of the frequency spectrum in which it is being used. Figure 3-2 illustrates a typical 3-dB YIG filter passband display at 4 GHz, using a 10 MHz/Div analyzer sweep. The Preselector is fixed-tuned to 4 GHz. The input signal is tuned through the passband.

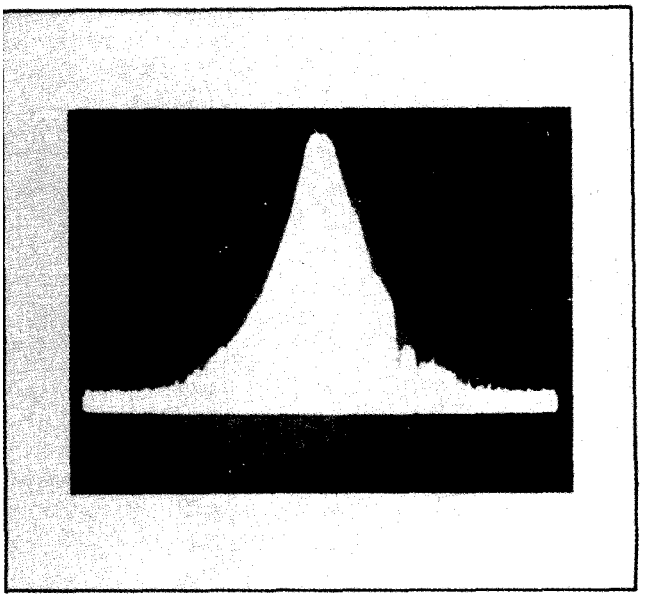


Figure 3-2. Typical 3-dB Yig Filter Pass band Display at 4 GHz and with a 10 MHz/DIV sweep.

3-14. PANEL FEATURES

3-15. Front and rear panel features of the Standard, Option 002, and Option 003 8445B Automatic Preselectors are described in Figure 3-3. Front and rear panel views of a Preselector connected to the HP 8555A/8552/141T Spectrum Analyzer are shown in Figures 3-4 and 3-5. For a detailed description of the Spectrum Analyzer controls and indicators refer to the appropriate operating and service manuals for those instruments. Interconnection wiring between the Preselector and the Spectrum Analyzer is contained in Section VIII of this manual.

Table 3-1. 8555A Frequency Ranges and Recommended Mixing Modes

Signal Frequency GHz	Recommended Mixing Modes (n)	Analyzer Frequency Range GHz
0.01 — 1.8	1−	0.01 — 2.05
1.8 — 3.5	1−*	1.50 — 3.55
2.8 — 4.5	1+*	2.60 — 4.65
2.8 — 5.5	2−	2.07 — 6.15
4.3 — 5.8	1+	4.11 — 6.15
4.9 — 9.0	3−	4.13 — 10.25
6.6 — 9.5	2+	6.17 — 10.25
7.3 — 13.0	4−	6.19 — 14.35
9.0 — 13.3	3+	8.23 — 14.35
11.0 — 18.0	4+	10.29 — 18.00

* Indicates .550 GHz IF. 2.05 GHz IF used on other bands.

3-16. OPERATOR'S CHECKS

3-17. Upon receipt of the instrument, or whenever the Preselector is to be used with a different analyzer, perform the Operator's Checks listed in Figures 3-4 and 3-5. These procedures correct for minor tracking differences between Preselector and Spectrum Analyzer.

3-18. OPERATING INSTRUCTIONS

3-19. General operating instructions are contained in Figure 3-3. These instructions will familiarize the operator with basic operating functions of the Preselector with the Spectrum Analyzer. Additional operating techniques and information are contained in Figures 3-4 and 3-5.

3-20. OPERATOR'S MAINTENANCE

3-21. Operator's Maintenance involves changing or replacing fuses, cleaning the air filter, and replacing a defective LINE switch lamp. Removing the air filter requires use of a Pozidriv screwdriver; all other operations do not require tools.

3-22. Fuses

3-23. The primary power fuse is found within the A6 Power Module assembly on the rear panel of the 8445B. A fuse change may be necessary when the instrument is moved to a location with a different ac line voltage or when the fuse has burned out. Steps one and three of Figure 2-1 show how the fuse is changed or replaced. Power Module fuse A6F 1, as well as internal A2 and A3 assembly fuse information is found in Section VI.

3-24. Air Filter

3-25. The air filter should be removed and cleaned periodically. It is recommended that it be checked every three months and, if necessary, washed in warm water and detergent. After washing allow the filter to dry for a few minutes before reinstallation.

3-26. Fan

3-27. The fan in this instrument is a self-lubricating unit and does not require maintenance.

3-28. Lamp Replacement

3-29. The lamp is contained in the white plastic lens which doubles as a pushbutton for the LINE switch. When the switch is ON, the lamp should be illuminated. Figure 3-6 illustrates how to remove and install the lamp. The lamp, DS1, maybe ordered under HP part number 2140-0244.

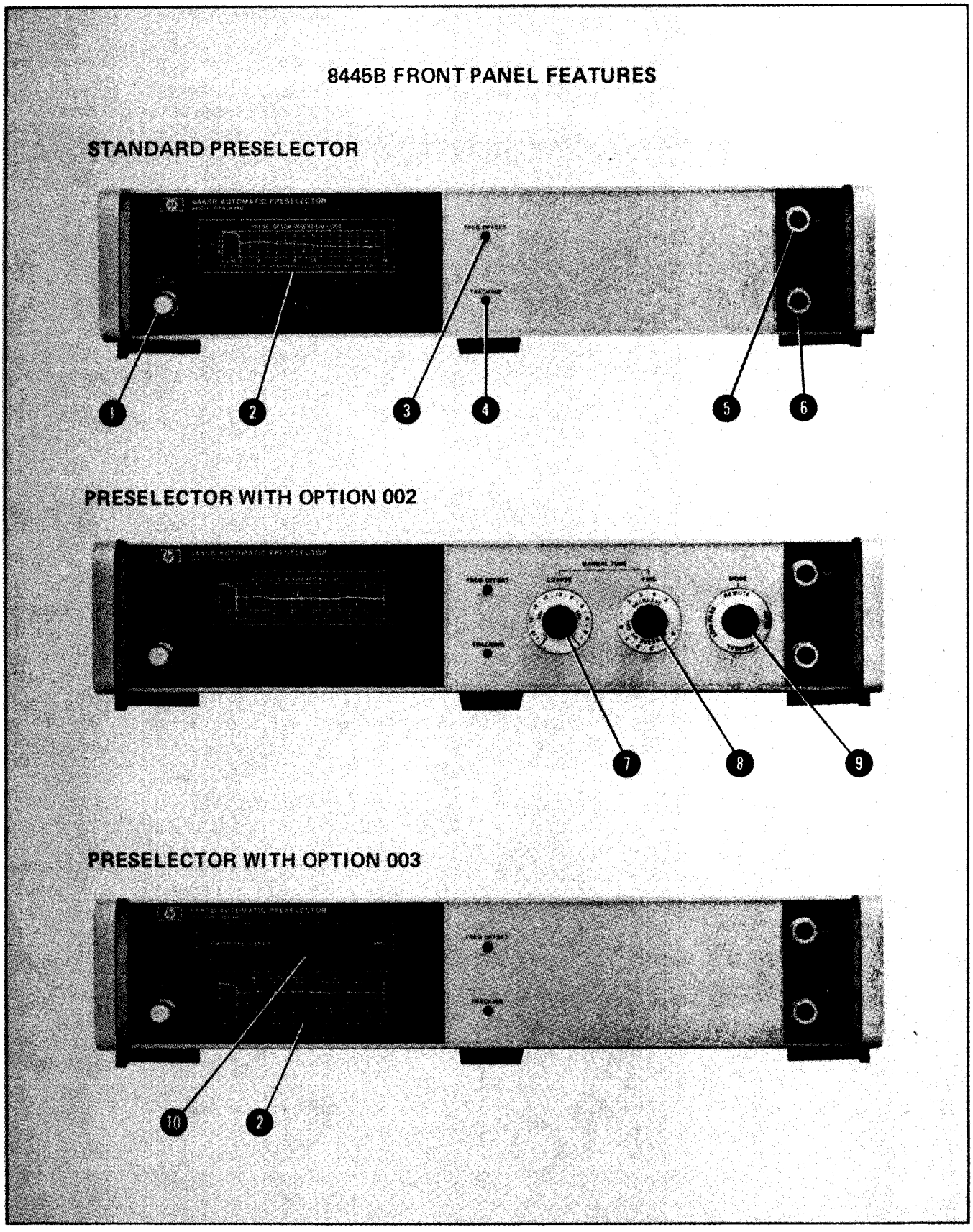


Figure 3-3. 8445B Controls, Connectors and Indicators (1 of 3)

8445B FRONT PANEL FEATURES

1. **LINE-ON/OFF.** Controls primary power. Light glows when switch is energized. Type A1H bulb.

2. **PRESELECTOR INSERTION LOSS Chart.** Indicates insertion loss versus frequency. Calibration chart extrapolated from point-to-point measurements of YIG filter insertion loss. FREQ OFFSET control adjusted for minimum insertion loss at each test point. During power level measurement, Spectrum Analyzer LOG REF LEVEL Vernier control may be adjusted to compensate for the indicated insertion loss.

3. **FREQ OFFSET.** Adjusts YIG driver to compensate for offset in YIG filter tuning due to residual magnetism in core structure. Adjusted to center the YIG filter at 2.0 GHz for wide range tracking. Adjusted for minimum filter insertion 1oss during power level measurements. (See Figure 3-5).

4. **TRACKING.** Adjusts YIG driver gain to match linear current-frequency curve of YIG filter. Adjusted during operational adjustments at a frequency of 8 GHz. Adjustment required to match tuning of Preselector with tuning of Spectrum Analyzer. Interacts with FREQ OFFSET adjustment. (See Figure 3-5).

5. **INPUT.** Type N coaxial connector normally provided. Option 001 instruments supplied with APC-7 connectors.

6. **OUTPUT.** Type N coaxial connector normally provided. Option 001 instruments supplied with APC-7 connector. See Table 1-3 for optional rigid coaxial interconnect cables.

7. **MANUAL TUNE COARSE - Option 002 Instruments.** Manual YIG filter frequency tune control. Sets YIG, filter center frequency in manual operating mode.

8. **MANUAL TUNE FINE - Option 002 Instruments.** Fine tune control for YIG filter frequency in manual operating mode.

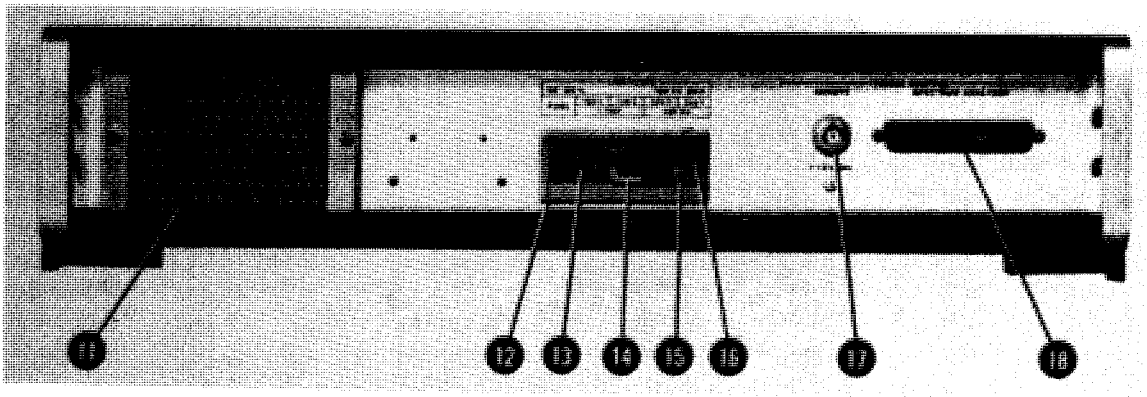
9. **MODE - Option 002 Instruments.** Selects Preselector mode of operation. MANUAL - YIG filter tuned by front panel controls. AUTO - Low-pass filter and/or YIG filter selected by control signals from analyzer RF Section. YIG frequency tuned by signal from RF Section. REMOTE - YIG filter tuned by input voltage to BNC connector on rear panel. LOW-PASS (except Option 004) - Selects 1.8 GHz low-pass filter. Inhibits Spectrum Analyzer control of Preselector.

10. **DIGITAL PANEL METER Frequency Readout - Option 003 Instruments.**

Indicates center frequency of the YIG filter passband in Manual or Remote Mode. In AUTOMATIC Mode, indicates center frequency of 8555A Spectrum Analyzer, reads zero above 18 GHz or in LOW-PASS Mode.

Figure 3-3. 8445B Controls, Connectors and Indicators (2 of 3)

84456 REAR PANEL FEATURES



11 **Air Intake.** Maintain at least 3-inch clearance from surrounding objects.

12 **Power Module Assembly.** 100,120,220 and 240 Vac +5%, - 10%; 48 to 440 Hz 100 VA max.

13 **Line Input.** Connects to external ac power supply.

14 **Line Voltage Selector Card.** Printed circuit board used to match the available line voltage to the transformer primary.

15 **Fuse extractor and selector Lock.** Prevents line voltage selector card from being removed until fuse is extracted.

16 **Line Input Fuse.** Rating of fuse to be used is marked on rear panel near the Power Module Assembly.

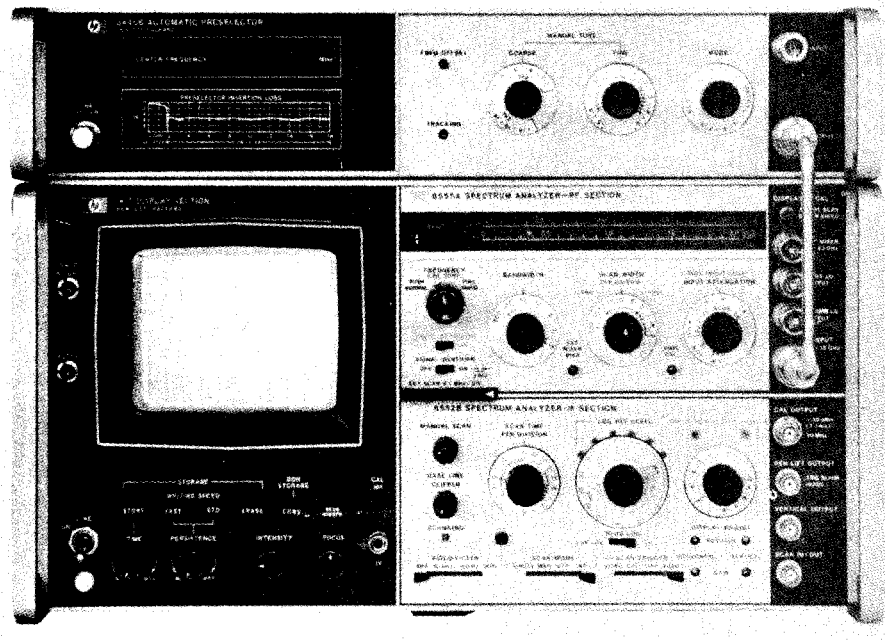
17 **TUNING CONTROL - REMOTE.** Input for remote tuning voltage to YIG filter. Enabled when Spectrum Analyzer is not operating (power off'), when interconnect cable is disconnected or (on Option 002) when the mode switch is set to REMOTE. Type BNC connector. YIG filter frequency to voltage ratio: 1.0 GHz/Volt.

18 **TUNING CONTROL - SPECTRUM ANALYZER Input.** Input control voltage (for selection of YIG or low-pass filter), YIG tuning voltage, and band code information. Disconnect input cable when using REMOTE input to tune YIG filter.

Figure 3-3. 8445B Controls, Connectors and Indicators (3 of 3)

OPERATOR'S CHECKS
USING LOW PASS FILTER

FRONT VIEW



REAR VIEW

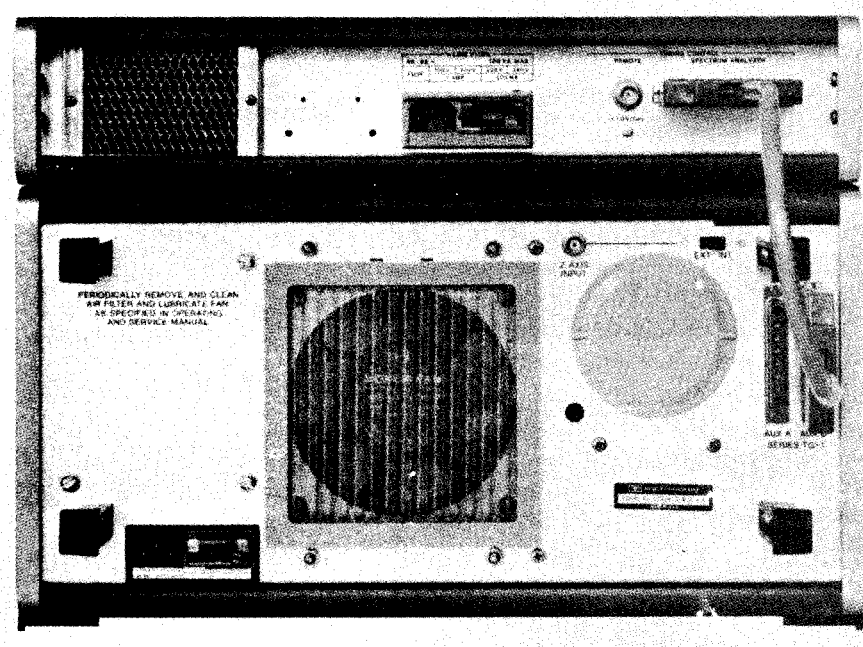


Figure 3-4. Low-Pass Filter Operation, 10 MHz to 1.8 GHz (1 of 3)

OPERATOR'S CHECKS USING LOW PASS FILTER

1. Check that the Line Voltage Selection Card is positioned to correspond to the available line voltage. Refer to the information on Line Voltage Selection in Section II.

2. Connect interconnect cable beween AUX B output on Spectrum Analyzer Display Section and TUNING CONTROL- SPECTRUM ANALYZER input on Preselector.

3. Connect Preselector and Spectrum Analyzer to line voltage source and apply power.

4. Perform Spectrum Analyzer Operational Adjustments in Section III of Spectrum Analyzer RF Section 8555A Operating and Service Manual.

NOTE

The information below does not apply to Automatic Preselectors with Option 004 which have no low-pass filters. Adjustments for such instruments are outlined in Figure 3-5.

5. Set analyzer LOG/LINEAR switch to LINEAR and rotate LOG REF LEVEL control until 1 mV/DIV is matched with the lighted index lamp.

6. Connect Analyzer CAL OUTPUT to INPUT of Preselector.

7. Connect rigid coaxial cable between Preselector OUTPUT and Analyzer INPUT.

8. Note and record low-pass filter insertion loss at 30 MHz. From 7th graticule line from bottom of CRT to 5th graticule line represents approximately 3 dB. Low-pass filter insertion loss should be< 1 dB.

9. Remove rigid coaxial cable connecting Preselector OUTPUT to Analyzer INPUT.

10. Set Analyzer INPUT ATTENUATION to 40 dB.

11. Set Analyzer LOG/LINEAR control to LOG.

12. Rotate LOG REF LEVEL control to (+) 10 dBm.

13. Set SCAN WIDTH PER DIVISION to 10 MHz and set FREQUENCY control to position cursor at 1.5 GHz on frequency scale.

14. With INPUT ATTENUATION at 40 dB, connect Analyzer SECOND LO OUTPUT to INPUT.

15. Center 1.5 GHz LO signal on CRT display. Reduce SCAN WIDTH PER DIVISION to 0.2 MHz, keeping signal centered on CRT with FREQUENCY control.

16. Rotate LOG REF LEVEL control fully counter-clockwise.

17. Set LOG/LINEAR switch to LINEAR and adjust LINEAR SENSITIVITY controls for a 7.1 division display of the 1.5 GHz signal.

Figure 3-4. Low-Pass Filter Operation, 10 MHz to 1.8 GHz (2 of 3)

OPERATOR'S CHECKS USING LOW PASS FILTER

18. Disconnect cable at Analyzer INPUT and couple to INPUT connector on Preselector.

19. Connect rigid coaxial cable between Preselector OUTPUT and Analyzer INPUT.

20. Note and record low-pass filter insertion loss at 1.5 GHz. From 7th graticule line (from bottom of CRT) to 5th graticule line represents approximately 3 dB. 1.5 GHz low-pass filter insertion loss ≤ 2.5 dB.

21. Set LOG/LINEAR switch to LOG. Set LOG REF LEVEL Vernier control to compensate for the amount of insertion loss indicated in step 20.

22. The Preselector and Analyzer are now calibrated at 1.5 GHz.

23. Remove cable between Preselector INPUT and Analyzer SECOND LO OUTPUT.

24. Install 50 ohm termination on SECOND LO OUTPUT connector.

25. Connect signal (10 MHz to 1.8 GHz) under investigation to INPUT connector of Preselector.

26. Set LOG REF LEVEL vernier control to compensate for insertion loss using data obtained in steps 8 or 20 or the data on the PRESELECTOR INSERTION LOSS chart.

Figure 3-4. Low-Pass Filter Operation, 10 MHz to 1.8 GHz (3 of 3)

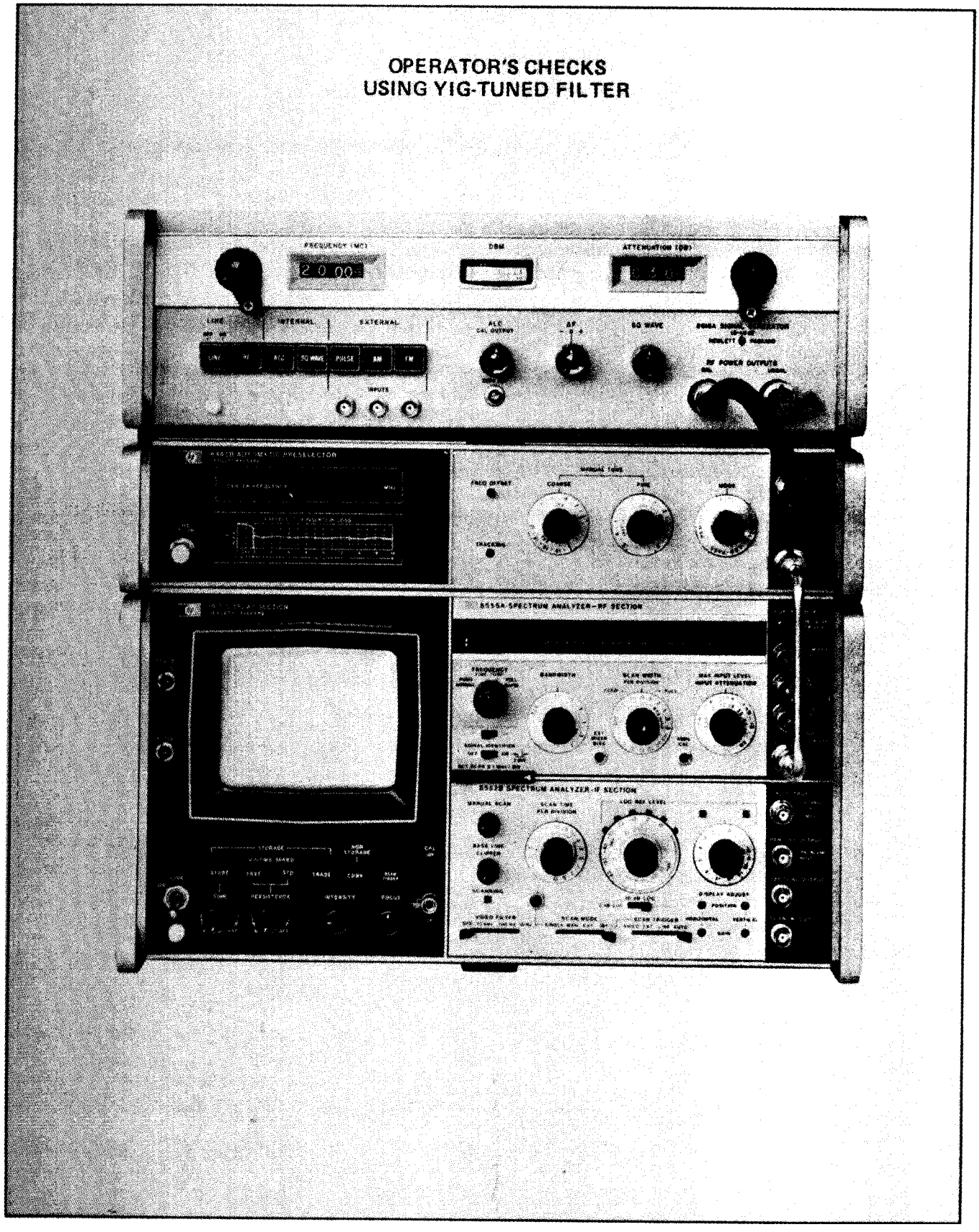


Figure 3-5. 1.8 to 18 GHz YIG-Tuned Filter Operation (1 of 3)

OPERATOR'S CHECKS USING YIG-TUNED FILTER

1. Check that the Line Voltage Selection Card is positioned to correspond to the available line voltage. Refer to information on Line Voltage Selection in Section II.
2. Connect interconnect cable W3 between AUX B output on Spectrum Analyzer Display Section and TUNING CONTROL - SPECTRUM ANALYZER input on Preselector.
3. Connect Preselector and Spectrum Analyzer to line voltage source and apply power.
4. Perform Spectrum Analyzer Operational Adjustments in Section III of Spectrum Analyzer RF Section 8555A Operating and Service Manual.
5. Connect the rigid W1 coaxial cable between Preselector OUTPUT and RF Section INPUT.
6. Set LOG REF LEVEL to 0 dBm.
7. Set SCAN WIDTH PER DIVISION to 10 MHz.
8. Connect a - 30 dBm 2.0 GHz signal to INPUT connector on Prelector.
9. Select n=1-/IF=550 MHz Frequency BAND and tune Analyzer FREQUENCY control to center the 2.0 GHz signal on CRT display.
10. Reduce SCAN WIDTH PER DIVISION to 0.5 MHz keeping signal centered on display with FREQUENCY control.
11. Reduce SCAN WIDTH PER DIVISION to 100 kHz; center signal on display with FINE TUNE control.
12. Set LOG/LINEAR switch to LINEAR and LINEAR SENSITIVITY control to 1 mV/DIV.
13. Adjust Preselector FREQ OFFSET control to center YIG filter passband on the 2 GHz signal and maximize signal on CRT display.
14. Set Analyzer LOG/LINEAR control to 10 dB LOG.
15. Rotate LOG REF LEVEL control to - 30 dBm.
16. Adjust LOG REF LEVEL Vernier control to position signal peak on LOG REF LEVEL graticule line.
17. Connect a - 30 dBm 8.0 GHz signal to INPUT Connector on Preselector.
18. Select n=2+/IF=2050 MHz Frequency BAND on Analyzer, set SCAN WIDTH PER DIVISION to 10 MHz, and tune FREQUENCY control to center the 8.0 GHz signal on CRT display.
19. Reduce SCAN WIDTH PER DIVISION to 0.5 MHz keeping signal centered on display with FREQUENCY control.

Figure 3-5. 1.8 to 18 GHz YIG-Tuned Filter Operation (2 of 3)

OPERATOR'S CHECKS USING YIG-TUNED FILTER

20. Reduce SCAN WIDTH PER DIVSION to 100 kHz; center signal on display with FINE TUNE control.

21. Set LOG/LINEAR switch to LINEAR and LINEAR SENSITIVITY control to 1 mV/DIV.

22. Adjust Preselector TRACKING control to maximize signal on CRT display.

23. If signal is already at maximum, no further adjustment of FREQ OFFSET or TRACKING is required.

24. If signal is not at maximum, repeat steps 7 through 22 until a setting is found which satisfies requirements of steps 13 and 22.

NOTE

Incorrect tracking of preselector to the Spectrum Analyzer may be due to aging or misadjustment of the 8555A YIG Driver Assembly. Follow the directions given in Section V of the 8555A Operating and Service Manual under YIG Driver Adjustments.

25. To check YIG filter tuning by an external dc voltage, set the -30 dBm signal source to 2 GHz and the 8555A to a band to display this frequency. Disconnect the W3 interconnect cable from the rear of either the 8445B or the 8555A.

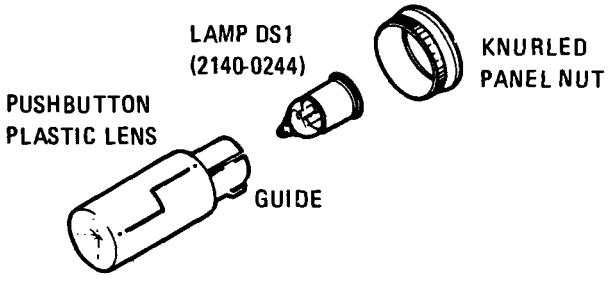
26. Apply a positive voltage from a variable dc power supply to the center connection of the REMOTE input BNC connector at the rear of the 8445B. Monitor the REMOTE input voltage with a voltmeter. The signal on the CRT should peak at +2 volts. (If not, the Remote Control Buffer Amplifier, described in Service Sheet 5, should be checked.)

27. Adjust signal source to 4 GHz and vary the dc voltage. The signal should peak on the CRT at +4 volts.

NOTE

When switching the 8555A INPUT ATTENUATION from 10 dB to 0 dB, signal level displayed on CRT may not change by 10 dB. This is due to the high mismatch error between the 8445B OUTPUT port and the 8555A INPUT port.

Figure 3-5. 1.8 to 18 GHz YIG-Tuned Filter Operation (3 of 3)



POWER LAMP REPLACEMENT

1. Remove lens by pulling straight out.
2. Replace lamp.
3. To replace lens, align guide with notch in receptacle. Push straight in.

Figure 3-6. Power Lamp Replacement

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's ability to operate in accordance with the electrical specifications given in Table 1-1. All of the tests can be performed without access to the inside of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-3. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specificaions given in the table may be substituted for the recommended model(s).

4-4. TEST RECORD

4-5. Results of the performance tests maybe tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-6. FRONT PANEL CHECKS

4-7. Before proceeding to the performance tests, the instrument must be adjusted and all controls set as specified in the preset adjustment instructions in paragraphs 4-8 and 4-9. After the instrument controls are preset, proceed with the front panel checks and adjustments. The instrument should perform as called out in the preset adjustment procedures before going on to the performance tests (paragraphs 4-17 through 4-20).

4-8. PRESET ADJUSTMENTS

4-9. Install Preselector with Spectrum Analyzer. Ensure that the line voltage selector is set to correspond with the available line voltage (refer to Line Voltage Selection in Section II). Connect interconnect cable between AUX B output on the Display Section and TUNING CONTROL-SPECTRUM ANALYZER input on the Preselector. Connect Preselector and Spectrum Analyzer to line voltage source and apply power. While the instruments are warming up, make the following control settings:

a. PRESELECTOR (with manual controls Option 002):

MODE . . . . AUTO

b. SPECTRUM ANALYZER

BAND . . . . . n=1-/IF=2.05 GHz
FREQUENCY . . . . 30 MHZ
FINE TUNE . . . . . Centered
BANDWIDTH . . . . . 100 kHz
SCAN WIDTH . . . . . PER DIVISION
SCAN WIDTH PER DIVISION . 10 MHz
INPUT ATTENUATION . . . . . 10 dB
SIGNAL IDENTIFIER . . . . . OFF
BASE LINE CLIPPER . . . . . CCW
SCAN TIME PER DIVISION
10 MILLISECONDS
LOG/LINEAR. . . . . 10 dB LOG
LOG REF LEVEL 0dBm
LOG REF LEVEL Vernier 0
VIDEO FILTER . . . . OFF
SCAN MODE . . . . . .INT
SCAN TRIGGER . . . . LINE

c. Connect Spectrum Analyzer CAL OUTPUT to its own INPUT.

d. Adjust FREQUENCY to align LO feedthrough signal on the -3 graticule line.

e. Check level of 30 MHz signal at CENTER FREQUENCY line. Singal level should be -30 dBm. Perform AMPL CAL Adjustment if signal level is incorrect. (See 8555A Operating and Service Manual.)

NOTE

Preselectors with Option 004 do not have low-pass filters installed. Disregard steps f, g, h, and i.

f. Connect Spectrum Analyzer CAL OUTPUT to INPUT port on Preselector.

g. Connect OUTPUT port of Preselector to Spectrum Analyzer INPUT.

h. Check level of 30 MHz signal at CENTER FREQUENCY graticule line. There should be little change in level of the -30dBm signal through the low-pass filter in the Preselector.

i. Select BAND n=1+/IF=.550 GHz. Note that there is an audible click (from coaxial switches in the Preselector) and the signal disappears from the CRT display.

j. Select BAND n=1–/IF=.550 GHz.

k. Connect a 2.0 GHz -30 dBm signal to preselector INPUT.

1. Tune Spectrum Analyzer to center the 2.0 GHz signal on CRT display.

m. Adjust Preselector FREQ OFFSET to peak the 2.0 GHz signal.

n. Select BAND n=3+ and connect a 12 GHz, -30 dBm signal to Preselector input.

o. Tune Spectrum Analyzer FREQUENCY control to center signal on CRT display.

p. Adjust Preselector TRACKING control to maximize signal level on CRT display.

q. Repeat steps j though p for optimum adjustment.

4-10. PERFORMANCE TESTS

4-11. The performance tests, given in this section, are suitable for incoming inspection, troubleshooting, or preventive maintenance. During any performance test, all shields and connecting hardware must be in place. The tests are designed to verify published instrument specifications. Perform the tests in the order given, and record data on test card (Table 4-1) and/or in the data spaces provided in each test.

4-12. The tests are arranged in the following order

Paragraph	Test Description
4-17	Out-of-Band Rejection
4-18	Low-Pass Filter Insertion Loss
4-19	YIG Filter Insertion Loss
4-20	Limiting Level (Signal Compression)

4-13. Each test is arranged so that the specification is written as it appears in Table 1-1, Specifications. Next, a description of the test and any special instructions or problem areas are included. Each test that requires test equipment has a test setup drawing and a list of required equipment. Step 1 of each procedure gives control settings required for that particular test.

4-14. Required minimum specifications for test equipment are detailed in Table 1-5. If substitute test equipment is used, it must meet the specifications listed in order to performance-test the Preselector.

4-15. ABBREVIATED PERFORMANCE TEST

4-16. To assure that the Preselector is performing properly without testing all of the specifications listed in Table 1-1, the following procedure is suggested as an abbreviated performance test:

a. Perform OPERATORS CHECKS in Figure 3-4 and Figure 3-5, as applicable.

b. Perform only the following performance tests:

1. Paragraph 4-18, Low-Pass Filter Insertion Loss Test.

2. Paragraph 4-19, YIG Filter Insertion Loss Test.

PERFORMANCE TESTS

4-17. OUT-OF-BAND REJECTION TEST

SPECIFICATION:

For YIG-tuned filter, 1 GHz from center of passband >70 dB.

4-17. OUT-OF-BAND REJECTION TEST (Cont'd)

DESCRIPTION:

The YIG filter is tuned to a 3 GHz fixed frequency (either manually or remotely by a + 3 Vdc to the REMOTE input). A 3 GHz signal is applied through the filter and the power output level measured. The signal source is then shifted 1 GHz and the power output level is again measured. The difference between the two power levels is the out-of-band rejection for 1 GHz frequency separation.

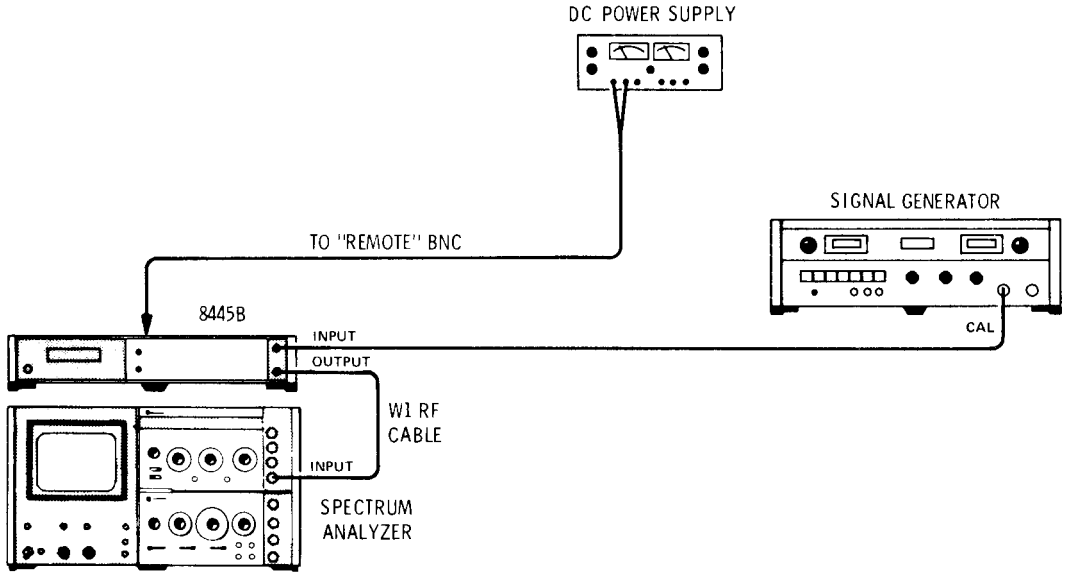


Figure 4-1. Out-of-Band Rejection Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8555A/8552/141T
Signal Generator	HP 8616A
Power Supply	HP 6205B
Coaxial Cable (BNC to alligator clips)*	HP10501A

***Required for Preselectors without manual controls.**

1. Connect test setup as indicated in Figure 41 and make the following control settings:

PRESELECTOR: (without manual controls)

LINE OFF/ON	ON
Interconnect able	Disconnected

PRESELECTOR: (with manual controls)

LINE OFF/ON	ON
MODE	MANUAL
MANUAL TUNE COARSE	3GHz
MANUAL TUNE FINE	0 GHZ

4-17. OUT OF BAND REJECTION TEST (Cont'd)

POWER SUPPLY:
- Output Voltage . . . . . +3Vdc

ANALYZER
- BAND . . . . . n=2-
- FREQUENCY . . . . . .3 GHz
- BANDWIDTH 300kHz
- SCAN WIDTH PER DIVSION . . . . . 10 MHz
- INPUT ATTENUATION 10dB
- BASE LINE CLIPPER . . . . . 12 o'clock
- SCAN TIME PER DIVISION . . . . 10 MILLISECONDS
- LOG REF LEVEL . . . . 0 dBm
- LOG/LINEAR . . . . . 10dB LOG
- VIDEO FILTER 10kHz

SIGNAL GENERATOR
- FREQUENCY 3GHz
- ATTENUATION . . . . 0 dBm
- ALC CAL OUTPUT . . . . 0 dBm(on meter)

2. Adjust Signal Generator frequency to center signal in Preselector passband indicated by maximum signal level displayed on CRT.

3. Adjust Spectrum Analyzer FREQUENCY control to center signal on CRT display.

4. Record Signal Generator frequency.

_____

5. Adjust Spectrum Analyzer LOG REF LEVEL Vernier control to set signal peak at LOG REFlineofCRT.

6. Remove RF interconnect cable from preselector out put to Spectrum Analyzer input and connect Signal Generator to Spectrum Analyzer Input. DO NOT CHANGE amplitude controls on Spectrum Analyzer or Signal Generator.

7. Tune Generator to a frequency 1 GHz above that recorded instep 4 above. Record frequency.

_____

8. Tune Spectrum Analyzer to frequency of Signal Generator.

9. Center Signal Generator signal on CRT display.

10. Reduce Spectrum Analyzer BANDWIDTH to 30 kHz and SCAN WIDTH PER DIVISION to 0.5 MHz. Center signal on CRT display with FINE TUNE control.

4-17. OUT OF BAND REJECTION TEST (Cont'd)

11. Reconnect Signal Generator output to Preselector input and interconnect cable to Spectrum Analyzer input and Prelector output.

12. Note and record signal level. Signal should be at least 70 dB below the reference level set in step 5

Out-of-Band Rejection _____ dB

4-18. LOW-PASS FILTER INSERTION LOSS TEST (Omit for Instruments with Option 004)

SPECIFICATION:

Low-Pass Filter Insertion Loss; Dc-1.8 GHz<2.5 dB. At 2.05 GHz>50 dB.

DESCRIPTION:

Insertion loss is measured at the high end of the filter's operating range(1.8 GHz)by applying a known input power level and measuring the output power level. Filter rejection at 2.05 GHz is measured in the same manner.

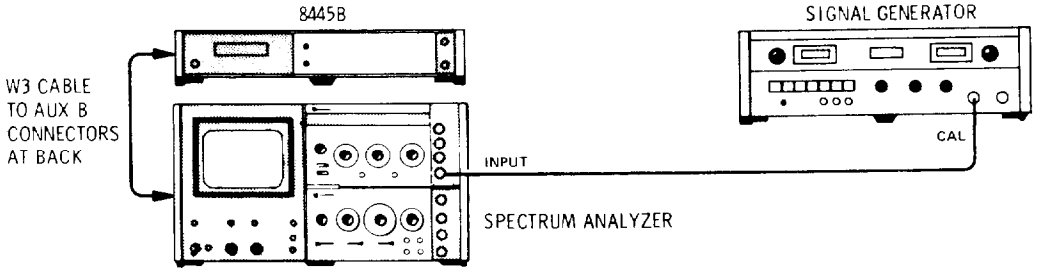


Figure 4-2. Insertion Loss Test Setup, Dc –1.8 GHz

EQUIPMENT:

Spectrum Analyzer . . . . . HP 8555A/8552/141T
Signal Generator . . . . . HP 8616A

4-18. LOW-PASS FILTER INSERTION LOSS TEST (Cont'd)

1. Connect test setup as indicated in Figure 4-2 and make the following control settings:

PRESELECTOR
- LINE OFF/ON . . . . . .ON

ANALYZER
- BAND . . . . . .n=1-/IF=2.05GHz
- FREQUENCY . . . . . .1.8 GHz
- BANDWIDTH, ...300 kHz
- SCAN WIDTH PER DIVISION . . . . . .10 MHZ
- INPUT ATTENUATION . . . . . 10 dB
- BASE LINE CLIPPER . . . . . 9 o'clock
- SCAN TIME PER DIVISION . . . . 10 MILLISECONDS
- LOG REF LEVEL . . . . . .-20 dBm
- LOG/LINEAR . . . . . .10 dB LOG
- VIDEO FILTER . . . . . 10 kHz
- SCAN MODE . . . . . .INT
- SCAN TRIGGER . . . . AUTO
- POWER . . . . . .ON

SIGNAL GENERATOR
- LINE . . . . . .On
- RF . . . . . .On
- ALC . . . . . .On
- FREQUENCY . . . . . 1800 MHz
- ATTENUATION . . . . . .10 dB

2. Center 1.8 GHz signal on CRT display with FREQUENCY control. Set TUNING STABILIZER to ON and reduce SCAN WIDTH PER DIVISION to 100kHz.Center signal on CRT display withFINE TUNE control.

3. Adjust Signal Generator CAL OUTPUT (8616A only) level for an indicated -20 dBm on CRT display.

4. Connect Signal Generator output to Preselector INPUT.

5. Connect Preselector OUTPUT to Analyzer INPUT.

6. Note and record insertion loss. Insertion loss should not exceed 2.5 dB.

≤2.5 dB _____ dB

7. Repeat steps 2 through 5 using 2050 MHz.

8. Insertion loss should be ≥ 50 dB.

≥50 dB _____ dB

PERFORMANCE TESTS

4-19. YIG FILTER INSERTION LOSS TEST

SPECIFICATION:

Tracking Filter Insertion Loss: 1.8 - 12 GHz, <8 dB; 12 - 18 GHz, <10 dB. (Option 004 only; 1.8 - 12 GHz, <7 dB; 12 - 18 GHz, <8 dB).

DESCRIPTION:

YIG filter insertion 1oss is measured at fixed frequency points by applying a known signal level, tuning the YIG filter passband to the signal and measuring the power out the filter output port. Perform the Operator's Check in Figure 3-5 prior to performing the test below. The operator's Check sets the FREQ OFFSET and TRACKING controls. The YIG filter is tuned by applying a voltage to the REMOTE input. Voltage to frequency tuning ratio is + 1 GHz/volt. The Preselector FREQ OFFSET control is used as a fine tuning control.

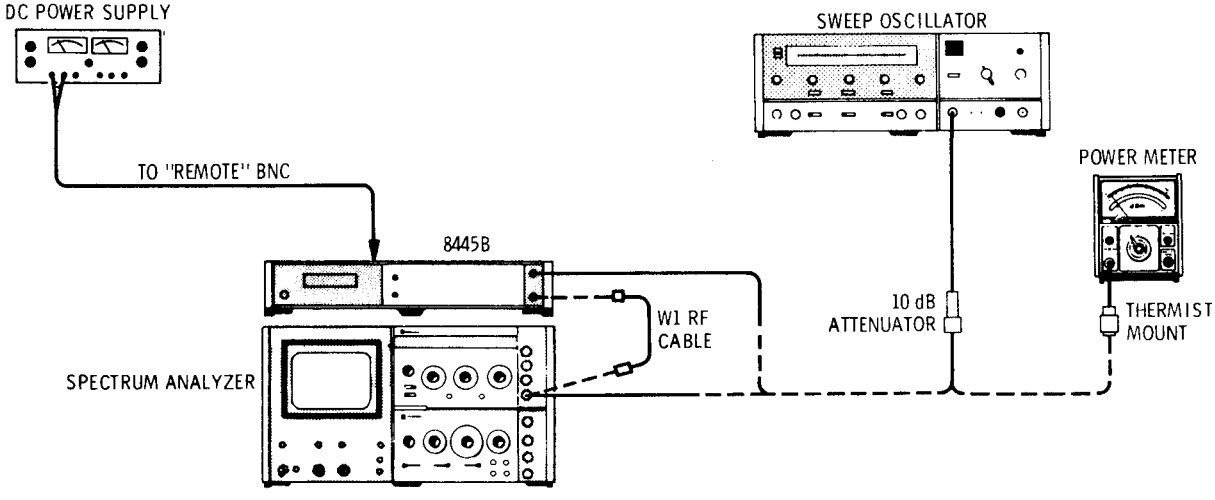


Figure 4-3. Insertion Loss Test Setup, 1.8 - 18 GHz

EQUIPMENT:

Power Meter & Power Sensor	HP 435A/8481A
Spectrum Analyzer	HP 8555A/8552/141T
Sweep Oscillator	HP 8620A/86290A
Power Supply	HP6205B
Coaxial Cable (BNC to alligator clips)	HP 10501A
Coaxial Attenuator, 10 dB	HP 8491B Option 010

4-19. YIG FILTER INSERTION LOSS TEST (Cont'd)

1. Connect test setup as indicated in Figure 4-3 and make the following control settings.

PRESELECTOR: (with manual controls)
- LINE OFF/ON ..... ON
- MODE ..... REMOTE

PRESELECTOR (without manual controls)
- LINE OFF/ON ..... ON
- Interconnect able ..... Disconnected

POWER SUPPLY:
- Output Voltage ..... +4.0 Vdc

SWEEP OSCILLATOR
- LINE ..... ON
- CW frequency ..... 4.0 GHz
- CW Pushbutton ..... Depressed
- ALC ..... INT
- RF ..... ON
- POWER LEVEL ..... 12 o'clock

ANALYZER
- BAND ..... n=2-
- FREQUENCY ..... 4.0 GHz
- SCAN WIDTH PER DIVISION ..... 10 MHZ
- INPUT ATTENUATION ..... 10 dB
- BASE LINE CLIPPER ..... 9 o'clock
- SCAN TIME PER DIVISION ..... 10 MILLISECONDS
- LOG REF LEVEL ..... -20dBm
- LOG LINEAR SWITCH ..... 10 dB LOG
- VIDEO FILTER ..... OFF
- SCAN MODE ..... INT
- SCAN TRIGGER ..... AUTO
- POWER ..... ON

2. Connect BNC fitting of coaxial cable to REMOTE input on Preselector.

3. Connect center conductor of coaxial cable to "+" terminal on Power Supply.

4. Connect outer conductor of coaxial cable to "-" terminal on Power Supply.

5. Connect Sweep Oscillator RF Output to Spectrum Analyzer INPUT.

6. Reduce Spectrum Analyzer SCAN WIDTH PER DIVISION to 1 MHz. Centersignal on CRT display with FREQUENCY control.

4-19. YIG FILTER INSERTION LOSS TEST (Cont'd)

7. Set SIGNAL IDENTIFIER swith to ON. Perform signal identification (see 8555A Manual) to ensure signal displayed is result of n=2- mixing mode. Set SIGNAL IDENTIFIER switch to OFF.

8. Adjust Sweep Oscillator POWER LEVEL and/or Analyzer LOG REF LEVEL Vernier for a convenient signal level.

9. Disconnect 10 dB attenuator from Spectrum Analyzer. Connect Power Meter and Power Sensor to 10 dB attenuator and measure power level. Record signal level.

_____ dBm

10. Connect Sweep Oscillator RF output with 10 dB attenuator to Preselector INPUT.

11. Install rigid coaxial cable W1 between Preselector OUTPUT and Spectrum Analyzer INPUT.

12. Adjust Power Supply Vernier voltage control for maximum signal level indication on CRT display.

NOTE

Tuning rate is critical. The frequency tuning of the Preselector passband is changed at a rate of 1 MHz/mV.

13. Adjust FREQ OFFSET to maximize signal level on CRT display.

14. Record signal level.

_____ dBm

15. Subtract level recorded in step 9.

_____ dB

16. Record insertion loss at 4 GHz. Insertion loss should be <8 dB at 4 GHz.

_____ dB

17. Repeat the above procedure at selected frequency points to 18 GHz. See specifications for acceptable limits of insertion loss.

4-20. LIMITING LEVEL TEST

SPECIFICATION:

> +5 dBm for <1 dB signal compression.

4-20. LIMITING LEVEL TEST (Cont'd)

DESCRIPTION:

YIG filter compression is checked at the low frequency end of the operating range (point of maximum filter compression). Compression is measured by applying a -5 dBm signal to the filter input; the power level at the filter output is measured to establish a reference level. The input power level is increased by 10 dB and the output level is checked for a corresponding increase. In the actual test, a 10 dB fixed attenuator is switched from between the signal source and filter to the filter output. Using this procedure, any change in output level would be due to compression and not to errors in the measurement test setup.

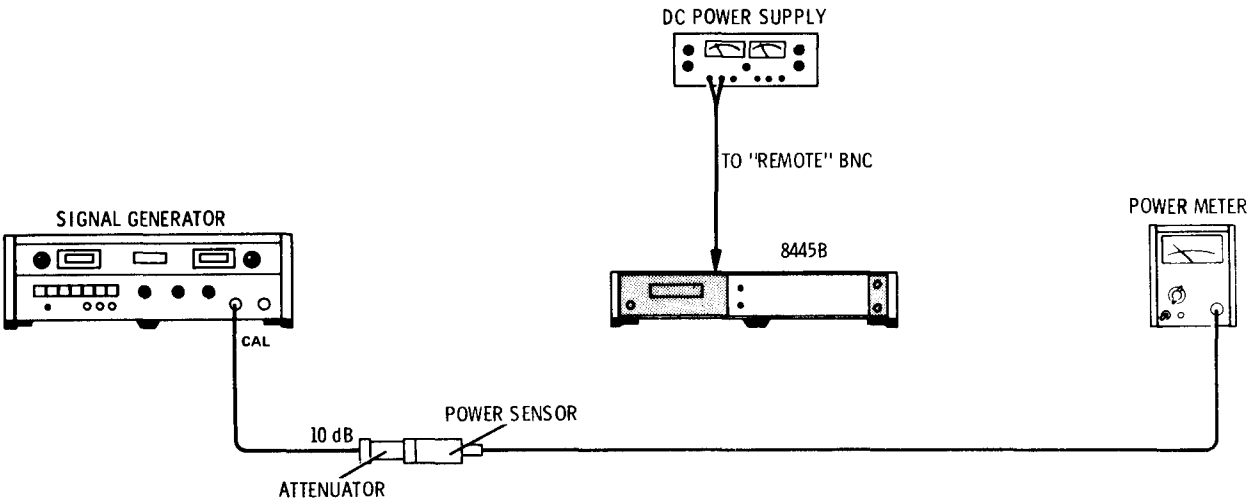


Figure 4-4. YIG Filter Signal Compression Test Setup

EQUIPMENT:

Power Meter& Power Sensor	HP 435A/8481A
Power Supply	HP 6205B
Signal Generator	HP 8616A
Coaxial Attenuator, 10 dB	HP 8491B Option 010

1. Connect test setup as indicated in Figure 4-4 and make the following control settings

PRESELECTOR:

LINE OFF/ON . . . . . ON

POWER SUPPLY:

Output Voltage 1.8Vdc

4-20. LIMITING LEVEL TEST (Cont'd)

SIGNAL GENERATOR:

LINE . . . . . .On
RF . . . . . .On
ALC . . . . . .On
FREQUENCY . . . .1800 MHz

POWER METER:

LINE . . . . . .ON
RANGE . . . . . .-5 dBm

2. Adjust Signal Generator output level for an indication of –5 dBm on Power Meter.

3. Connect Signal Generator output through the 10 dB attenuator to Preselector INPUT.

4. Connect Power Meter and Power Sensor to Preselector OUTPUT.

5. Adjust Power Supply Fine Voltage control for maximum power level indication on Power Meter.

6. Adjust Preselector FREQ OFFSET control for maximum power level indication on Power Meter.

NOTE

Indicated power meter level should correspond with the insertion loss indicated on Preselector calibration label. Typically 4 dB below the level established in step 2 above.

7. Note and record level indicated on Power Meter.

_____ dBm

8. Remove 10 dB Attenuator from Signal Generator to Preselector path and install in Preselector to Power Sensor path.

9. Note and record level indicated on Power Meter.

_____ dBm

10. Record compression loss; difference between levels recorded in steps 9 and 7 above. Compression should be less than 1 dB.

_____ dB

Table 4-1. Performance Test Record

Hewlett-Packard Model 8445B Preselector

Tests Performed by: _____

Serial No.: _____

Date: _____

Para. No.	Test	Minimum	Actual	Maximum
4-17	**OUT/OF-BAND REJECTION** 4. Reference Frequency 7. Measurement Frequency 12. Out-of-Band Rejection	 70 dB	 _____GHz _____GHz _____ dB	
4-18	**LOW-PASS FILTER INSERTION LOSS** **3.** Reference Level 6. Insertion Loss 8. 2050 MHz Insertion Loss	 50 dB	 —dBm _____ dB — dB	 2.5 dB
4-19	**YIG FILTER INSERTION LOSS** 1. Reference Frequency 9. Reference Signal Level 14. Preselector Signal Level 16. Insertion Loss 17. Reference Frequency Reference Signal Level Preselector Signal Level Insertion Loss	 	 4 GHz _____ dBm _____ dBm _____ dB _____ GHz _____ dBm _____ dBm _____ dB	 8 dB _____
4-20	**LIMITING LEVEL** 1. Reference Frequency 7. Reference Level 9. Measurement Level 10. Compression Loss	 	 1.8 GHz _____ dBm _____ dBm _____ dB	 1 dB

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments required to return the Preselector to peak operating condition when repairs are required. Included in this section are test setups, checks, and adjustment procedures.

5-3. EQUIPMENT REQUIRED

Table 5-1. Adjustable Controls and Factory Selected Component

Control Reference Designation See NOTE Below	Name	Function
A1R34/R38	Null Control	Nulls A1U1
A1R35/R39	Null Control	Nulls A1U2
A1R36/R40	550 MHz IF Offset	Adds correct voltage to Summing Amplifier to Offset for 550 MHz IF.
AIR37/R41	2.05 GHz IF Offset	Adds correct voltage to Summing Amplifier to Offset for 2.05 GHz IF.
A1R42/R46	*Null Control*	*Nulls A1U5*
A2R5	+ 19.5 Vdc Adjust	Sets regulated + 19.5 Vdc
A3R7	Coarse Offset	
A3R13*	COARSE TRACKING range	Selected component. Typical value 26.1 ohms. Adjusts COARSE TRACKING circuit.
A3R24	15 GHz Breakpoint Adjust	Corrects for YIG Magnet saturation
A3R29	18 GHz Breakpoint Adjust	Corrects for YIG Magnet Saturation
A7R12	*Z (Zero Adjust)*	*Adjusts DPM to zero volts (0 GHz)*
A7R58	– (Negative Adjust)	Adjusts DPM for 18 volts (18 GHz)

Note: Items in italics and underlined are used in Option 003 instruments.

***Factory selected component**

5-4. Each adjustment procedure contains a list of test equipment for that particular test. Table 1-4 contains a list of test equipment and accessories required in the adjustment procedures. In addition, the table contains the required minimum specifications and a suggested manufacturer's model number.

5-5. FACTORY SELECTED COMPONENTS

5-6. Table 5-1 contains a list of adjustable controls and factory selected components by reference designation, name, and function. Approximate location of a component can be determined by its assembly letter-number (as A1) designation preceding its component number. Factory selected components are designated by an asterisk (*) in the table and on the schematic diagrams in Section VIII.

5-7. RELATED ADJUSTMENTS

5-8. The adjustment procedures of this section are arranged in numerical order. For best results, this order should be followed. All data taken during adjustments should be recorded in the spaces provided Comparison of initial data with that taken during subsequent periodic adjustments assists in preventive maintenance and troubleshooting.

5-9. LOCATION OF ADJUSTMENTS

5-10. The locations of all components used in making adjustment tests are illustrated on photographs adjacent to related Service Sheets or on the last fold-out page in Section VIII (Figures 8-20 and 8-21.) Table 5-1 lists all of the controls used in making adjustment tests as well as all factory selected com ponents.

WARNING

Line voltage is always present on terminals including the power input connector, fuse holder, power switch, power transformer, etc. In addition, when the instrument is on, energy available at many points may result in personal injury or death when contacted.

ADJUSTMENTS

5-11. POWER SUPPLIES ADJUSTMENT

REFERENCE:

Service Sheets 4 and 6

DESCRIPTION:

Power supplies in the Preselector provide regulated outputs of +19.5, +28, and -23 volts and an unregulated output of +40 volts. Only the +19.5 voit supply is adjustable. These checks verify proper operation of the power supplies.

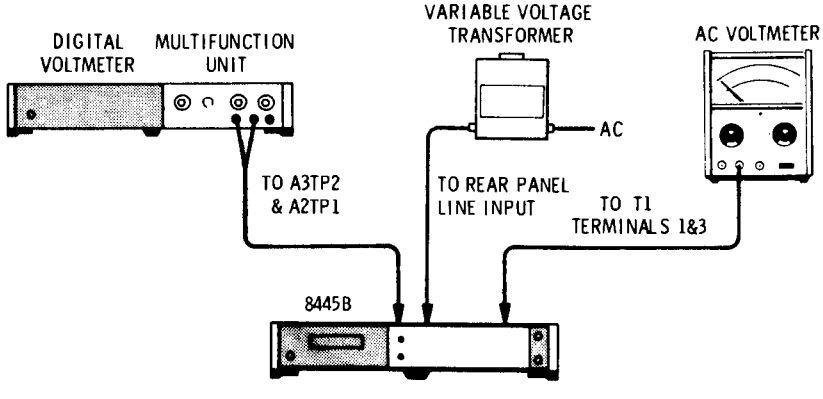


Figure 5-1. Power Supply Adjustment Test Setup

5-11. POWER SUPPLIES ADJUSTMENT (Cont'd)

EQUIPMENT:

Digital Voltmeter with Multifunction Unit . . . . . HP 3480B/3484A
Ac Voltmeter . . . . HP 427A
Variable Voltage Transformer . . . . General Radio W5MT3A

1. Connect test setup as indicated in Figure 5-1. Assure line voltage Power Module printed circuit card is set for the nominal voltage value closest to the existing line voltage (paragraphs 2-7 to 2-9).
   Nominal voltage used _____ Vac

2. With power line switch OFF, connect the variable voltage transformer between power line and Preselector. Adjust ac input to Preselector to the nominal line voltage value, as indicated on ac Voltmeter.

3. Turn power line switch and voltmeter ON. Allow 30 minutes for instruments to stabilize.

4. Remove Preselector top cover and connect the dc digital voltmeter test leads to the +19.5 V test point A2TP1, and to the common ground point A3TP2.

5. Adjust A2R5 (+19.5 V ADJ) for 19.500 Vdc on the dc digital voltmeter.

6. With the variable voltage transformer increase the ac line voltage to the Preselector 5%. Record any dc voltage variation (should not exceed 20 m Vdc).
   Change noted _____ Vdc

7. Decrease the ac input 10% below the nominal line voltage level and record any change (should not exceed 20 m Vdc). Change noted _____ Vdc

8. Adjust to nominal ac line voltage input. Measure and record the three other power supply levels at the test points listed:

   a. +40 V ± 2 V at pin 4 (on YIG-TEK YIGs), or at the - pin (on VARIAN YIGs).
      _____Vdc

   b. +28 V ±1.4 V at white-wire connection on the 2-terminal tie-point adjacent to the YIG (YIG heater supply, not used with VARIAN YIGs). _____Vdc

   c. - 23 V ± 1.2 V at test point A2TP7 (Op Amp bias). _____Vdc

9. If dc supplies are out of tolerance, refer to Service Sheets 4 and 6 for trouble isolation procedures.

5-12. YIG OR DPM PRE-DRIVER ADJUSTMENT

REFERENCE:

Service Sheets 2, 3, and 4.

5-12. YIG OR DPM PRE-DRIVER ADJUSTMENT (Cont'd)

DESCRIPTION:

With the Preselector connected to the Spectrum Analyzer, the Predriver Assembly A6 is checked and adjusted for an output voltage that tracks the tuned frequency of the Spectrum Analyzer. All operational amplifiers amplifiers are adjusted for balance and checked for correct gain. Voltage offset is adjusted to correspond to the 550 MHz or 2050 MHz IF of the Spectrum Analyzer.

NOTE

Instructions in *italics and underlined* refer to Option 003 instruments only.

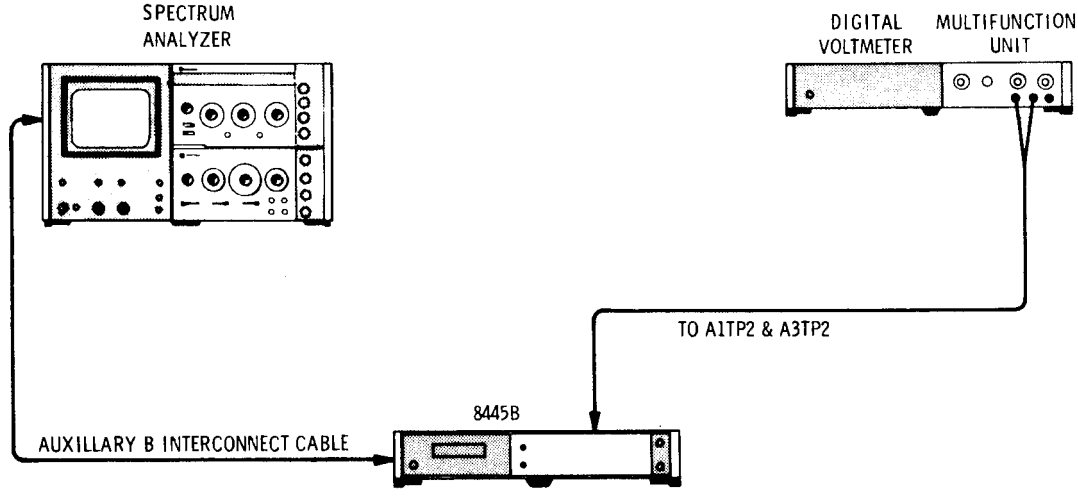


Figure 5-2. Pre-Driver Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552/141T
Digital Voltmeter with Multifunction Unit . . . . . HP 3480B/3484A

NOTE

For Option 003 instruments the A7 Digital Display Assembly must be removed prior to any Pre-Driver adjustments. Remove A7 by disconnecting the input cable on the rear of the assembly and by removing two screws from the mounting bracket adjacent to the "P1" marking on the main deck.

1. Connect test setup as shown in Figure 5-2.

2. Apply power to both Preselector and Spectrum Analyzer. Allow at least 30 minutes for equipment to stabilize.

5-12. YIG OR DPM PRE-DRIVER ADJUSTMENT (Cont'd)

3. Set Spectrum Analyzer controls as follows:

BAND . . . . . .n=2-
SCAN WIDTH . . . . ZERO
INPUT ATTENUATION . . . . . 10 dB
SCAN TIME PER DIVISION . . . .10 MILLISECONDS
SCAN MODE . . . . . .INT
SCAN TRIGGER . . . . AUTO
LOG/LINEAR . . . . . 10 dB LOG
LOG REFERENCE LEVEL . . . . . .-10 dBm

NOTE

All dc voltages are measured with respect to common ground test point, A3TP2.

4. Set switch A1S1 *and A1S2* to TEST position.

5. Set switch A3S1 to TEST position.

6. Set the voltage at the following test points (in specified order) with the appropriate pot.

Test Point	Adjust	Limits
A1TP2	A1R34	0.00 ± 0.20 mV
A1TP5	A1R42	0.00 ± 0.20 mV
A1TP7	A1R35	0.00 ± 0.20 mV
A1TP4	*A1R38*	*0.00 ± 0.20 mV*
A1TP6	*A1R46*	*0.00 ± 0.20 mV*
A1TP8	*A1R39*	*0.00 ± 0.20 mV*

7. Set A3S1 to OPR.

8. Adjust A1R37 *and A1R41* to obtain +2.000 V at A1TP7 and A1TP8 respectively.

9. Set Spectrum Analyzer to BAND n=2+ and verify voltage at A1TP7 *and A1TP8*. Voltage should be -2.000 ± 0.002 v.

-1.998 _____ -2.002V

10. Set to BAND n=1+/IF=.550 GHz. Adjust A1R36 *and A1R40* to obtain -536.6 mV at A1TP7 *and A1TP8 respectively.*

11. Set to BAND n=1-/IF=.550 GHz and verify voltage at A1TP7 *and A1TP8.* Voltage should be +536.6 ± 2.0 mV.

+534.6 _____ +538.6 mV

5-12. YIG OR DPM PRE-DRIVER ADJUSTMENT (Cont'd)

12. Set A1S1 *and A1S2* to OPR, A3S1 to TEST, and to BAND n=1-/IF=.550 GHz.

13. Adjust Spectrum Analyzer FREQUENCY for -3.000 V at A1TP7 in Preselector.

14. Check voltage at A1TP7 versus BAND setting.

Band	A1TP7 Voltage	
	Lower Limit	Upper Limit
n=1+/IF=.550 GHz	−3.002 V	−2.998
n=1−/IF=2.05 GHz	−3.002 V	−2.998
n=1+/IF=2.05 GHz	−3.002 V	−2.998
n=2−/IF=2.05 GHz	−6.003 V	−5.997
n=2+/IF=2.05 GHz	−6.003 V	−5.997
n=3−/IF=2.05 GHz	−9.004 V	−8.996
n=3+/IF=2.05 GHz	−9.004 V	−8.996
n=4−/IF=2.05 GHz	−12.005 V	−11.995
n=4+/IF=2.05 GHz	−12.005 V	−11.995

15. *Set to BAND n=1-/IF=.55O GHZ and adjust FREQUENCY control for -3. 000V at A1TP8*

16. *Check voltage and A1TP8 versus BAND setting. Use same limits as in step 14.*

17. Set A3S1 to OPR.

5.13 YIG DRIVER ADJUSTMENT

REFERENCE:

Service Sheets 4 and *5*

DESCRIPTION:

The YIG Driver is adjusted for linear frequency tracking with voltage. Course Tracking and Course Offset controls are adjusted for proper YIG Driver tuning sensitivity. The YIG linearity correction breakpoints are adjusted to compensate for saturation in the YIG core at the higher frequencies.

5-13. YIG DRIVER ADJUSTMENT (Cont'd)

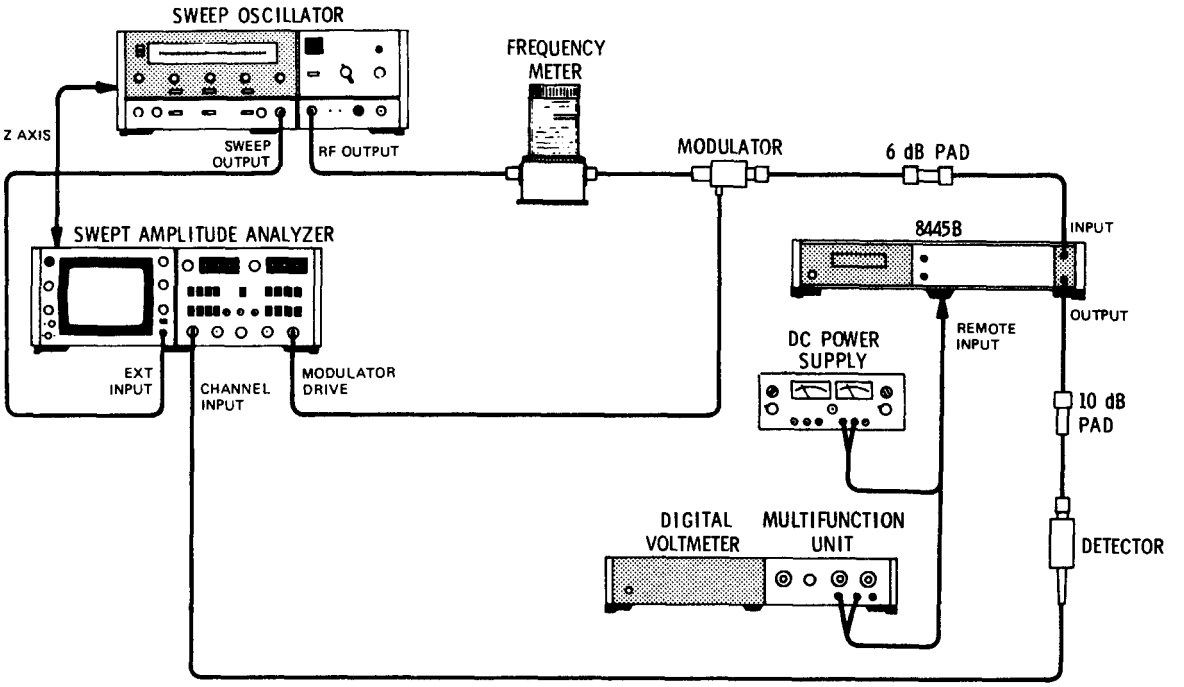


Figure 5-3. YIG Driver Adjustment Test Setup

EQUIPMENT:

Sweep Oscillator (2-18 GHz)	HP 8620A/86290A
Swept Amplitude Analyzer (2-18 GHz)	HP 8755A/180D
Dc Power Supply	HP 6205B
Frequency Meter	HP 536A
Frequency Meter	HP 537A
Frequency Meter	HP P532A
Digital Voltmeter with 3484A Multifunction Unit	HP 3480B
Detector (2-18 GHz)	HP 11664A
Modulator (2-18 GHz)	HP 11665B
Coaxial Attenuator, 6 dB	HP 8491B Option 006
Coaxial Attenuator, 10 dB	HP 8491B Option 010

1. Connect test setup as shown in Figure 5-3. Apply power and allow at least 30 minutes for equipment to stabilize.

NOTE

Perform the Power Supply and Pre-Driver Adjustments prior to performing the YIG Driver Adjustments.

2. Set the Preselector for remote operation and center the front panel FREQ OFFSET control, R1.

5-13. YIG DRIVER ADJUSTMENT (Cont'd)

3. Center the panel TRACKING potentiometer, R2.

4. Adjust power supply for +1.951 Vdc ±1 mVdc at A3TP4 (equivalent to +2.000 Vdc at REMOTE input).

5. Set sweep oscillator to 2 GHz with a 0.2 GHz ΔF sweep and set frequency meter to 2 GHz.

6. Adjust COARSE FREQ OFFSET control A3R7 to center frequency meter dip in the YIG filter passband.

7. Adjust power supply for +13.66 Vdc ±0.01 Vdc at A3TP4 (equivalent to +14.00 Vdc at REMOTE input).

8. Set the sweep oscillator for 14 GHz with a 0.5 GHz ΔF sweep, and set frequency meter to 14 GHz.

9. Adjust COARSE TRACKING control A3R21 to center the frequency meter dip in the YIG filter passband. If A3R21 has insufficient range, select values of A3R13 until the required A3R21 adjustment can be made.

10. Since the COARSE TRACKING and COARSE FREQ OFFSET adjustments interact, repeat steps 5 through 9.

11. Set power supply for +15.61 Vdc ±0.01 Vdc at A3TP4 (equivalent to + 16.00 Vdc at REMOTE input).

12. Set sweep oscillator to 16 GHz with a 0.5 GHz ΔF sweep and set frequency meter to 16 GHz.

13. Adjust A3R24 16 GHz ADJ to center frequency meter dip in the YIG filter passband.

14. Set power supply for +17.56 Vdc ±0.01 Vdc at A3TP4 (equivalent to + 18.00 Vdc at REMOTE input).

15. Set sweep oscillator and frequency meter to 18 GHz.

16. Adjust A3R29 18 GHz ADJ control to center frequency meter dip in the YIG filter passband.

5-14. DIGITAL PANEL METER ADJUSTMENT (Option 003)

REFERENCE:

Service Sheet 3

DESCRIPTION:

The digital panel meter is first adjusted to indicate zero when the 8555A Spectrum Analyzer is adjusted to zero frequency, and then to indicate 18450 when the 8555A is set to 18.450 GHz.

5-14. DIGITAL PANEL METER ADJUSTMENT (Option 003) (Cont'd)

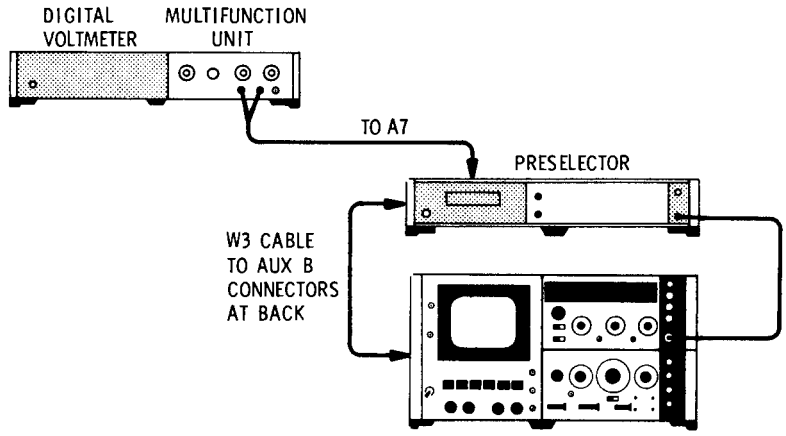


Figure 5-4. Digital Panel Meter Adjustment Test Setup.

EQUIPMENT:

Digital Voltmeter (5 digit) . . . . . HP 3480B/3484A

NOTE

Before adjusting digital panel meter circuits, the 8555A Spectrum Analyzer circuits must be correctly adjusted according to 8555A Manual instructions.

1. Couple the 8555A to the 8445B. After applying power to the instruments allow 30 minutes for the circuits to stabilize.

2. Remove top cover of the 8445B Preselector.

3. Connect the + lead of the multifunction digital voltmeter to the Teflon insulated standoff to which the blue-white wire is connected at the right-hand rear portion of the A7 chassis. Connect the - lead to the standoff to which the black-white wire is connected.

4. Set the 8555A Spectrum Analyzer to BAND n= 1-/IF= 2.05 GHz. If the Preselector has Option 002 panel controls, set MODE switch to AUTO operation. Adjust the 8555A FREQUENCY control to obtain a reading of 0.000 Vdc ±0.001 Vdc on the multifunction digital voltmeter.

5. If the Preselector DPM does not read within one count of zero, adjust the "Z" control on the rear panel surface of the DPM to produce 00000 ± 1 count on the DPM.

6. Connect the multifunction digital voltmeter between A1TP3 and A3TP2. If the value is not -7.500 Vdc ±0.003 Vdc, the trouble is due to either a misadjusted DPM Driver, or a component failure within the DPM portion of the A1 assembly. (See Service Sheets 2 and 3 for adjustments.)

7. Connect the multifunction digital voltmeter as in step 3. Set the 8555A to BAND n=4+, and FREQUENCY to 18.450 GHz. Adjust the 8555A FREQUENCY control for a reading of 18.000 Vdc ±0.001 Vdc on the multifunction digital voltmeter (equivalent to a frequency display of 18.450 GHz).

5-14. DIGITAL PANEL METER ADJUSTMENT (Option 003) (Cont'd)

8. If the DPM is not reading 18450 ±5 counts, adjust the "-" control on the rear panel surface of the DPM to this value.

9. Connect the multifunction digital voltmeter between A1TP3 and A3TP2. If the voltage is not -15,000 Vdc ±.006 Vdc, the trouble is within the DPM Predriver section of the A1assembly. (See Service Sheets 2 and 3 for adjustments.)

5-15. INSERTION LOSS CHART FOR REPLACEMENT YIG

DESCRIPTION:

After a replacement YIG filter is installed in a Preselector, a corrected Insertion Loss Chart should be developed for the new YIG filter. Use the following procedure.

1. Set up the YIG FILTER INSERTION LOSS TEST for a frequency of 4 GHz as described in paragraph 4-19. Record the loss in dB in the proper blank below.

2. Repeat the same test, inserting insertion loss values, for the additional frequencies listed.

3. Send a copy of the data, including Option number of instrument, if any, to your local Hewlett-Packard office. Arrangements will be made with the factory to produce a replacement front panel Insertion Loss Chart. (The Insertion Loss Chart curve for the original YIG filter was developed from data taken at these same frequencies.)

Table 5-2. Insertion Loss Table

Frequency (GHz)	Loss (dB)	Frequency (GHz)	Loss (dB)
1.8	_____	10	_____
2	_____	12	_____
3	_____	14	_____
4	_____	16	_____
6	_____	18	_____
8	_____		

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to instruments for which the content does not apply directly.

7-3. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

7-4. If your instrument serial number is not listed on the title page of this manual, or in Table 7-1 below, it maybe documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Serial Number Change History

Sarial Prefix or Number	Make Manual Changes
1326A	A
1318A	A,B
1251A	A,B,C

7-5. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Page 8-19, Figure 8-8 (Service Sheet 4):
Change A3R6* to 100 ohms.

CHANGE B

Page 8-19, Figure 8-8 (Service Sheet 4):
Delete terminal strip TB2 as shown in partial schematic Figure 7-2.

CHANGE C

Page 5-5, following Paragraph 5-12:
Insert the following Paragraph 5-12A, REMOTE AMPLIFIER ADJUSTMENT.

5-12A. REMOTE AMPLIFIER ADJUSTMENT

REFERENCE:

Service Sheet 5.

DESCRIPTION:

The remote amplifier A2U3 is adjusted for null, common-mode and differential-mode. The adjustments are repeated until settings are found that satisfy null, common-mode and differential-mode requirements.

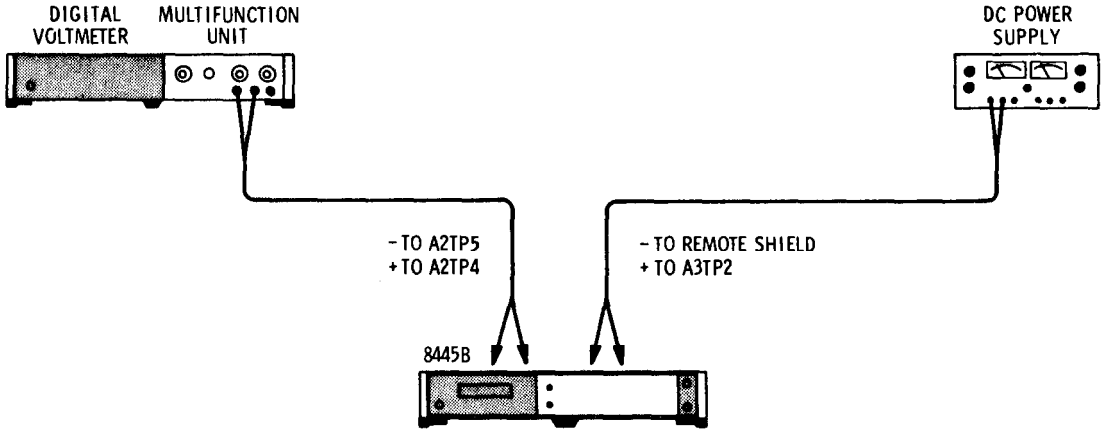


Figure 7-1. Remote Amplifier Adjustment Test Setup (Figure 5-3) (P/O CHANGE C)

EQUIPMENT:

Power Supply (0 to 10 Vdc) . . . . . HP 6205B
Coaxial Cable (BNC to alligator clips). . . . . HP 10501A
Four foot test leads with alligator clips (2 each)
Digital Voltmeter with Multifunction Unit . . . . . HP 3480B/3484A

1. With test setup as indicated in Figure 7-1, apply power to Preselector and allow at least 30 minutes for equipment to stabilize.

2. Connect "+" terminal of power supply to A3TP2.

3. Connect "-" terminal of power supply to REMOTE connector shield. Ground the negative terminal of the power supply with the shorting bar.

4. Connect "+" terminal of digital voltmeter to A2TP4.

5. Connect "–" terminal of digital voltmeter to A2TP5.

6. Set power supply output voltage to zero and connect REMOTE connector center conductor to "–" terminal of power supply. (REMOTE center pin and shield now shorted together.)

7. Adjust A2R23 NULL for zero indication on digital voltmeter. Remove short across REMOTE Center pin and shield.

5-12A. REMOTE AMPLIFIER ADJUSTMENT (cont'd)

8. Common-mode adjustment:

   a. Set power supply output voltage to 10 volts.

   b. Note error voltage indicated by voltmeter.

   c. Alternately adjust A2R20 and A2R21 for a zero indication on voltmeter. Remove about half the error voltage with each potentiometer.

9. Differential-mode adjustment:

   a. Set power supply output voltage to zero.

   b. Connect REMOTE connector center conductor to "+" terminal of power supply.

   c. Connect "–" terminal of digital voltmeter to A2TP2.

   d. Adjust A2R23 NULL for zero indication on voltmeter.

   e. Set Power Supply output voltage to 10 volts.

   f. Alternately adjust A2R20 and A2R21 for zero indication on voltmeter, removing about half the error voltage with each potentiometer.

10. Repeat steps 2 through 9 until settings are found which simultaneously satisfy all modes within a tolerance of ±1.0 millivolts.

11. Note and record digital voltmeter indication for each mode.

Common-mode _____ mV
Differential-mode _____ mV

Page 8-9, Figure 8-21 (Service Sheet 5):
Change the circuit diagram as shown in partial schematic Figure 7-3.

5-12A. REMOTE AMPLIFIER ADJUSTMENT (Cont'd)

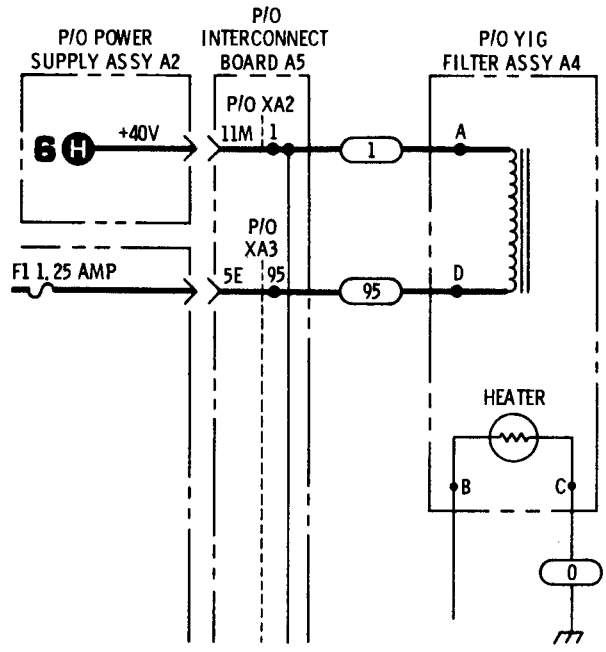


Figure 7-2. Partial Schematic correction for Service Sheet 4. (P/O CHANGE C)

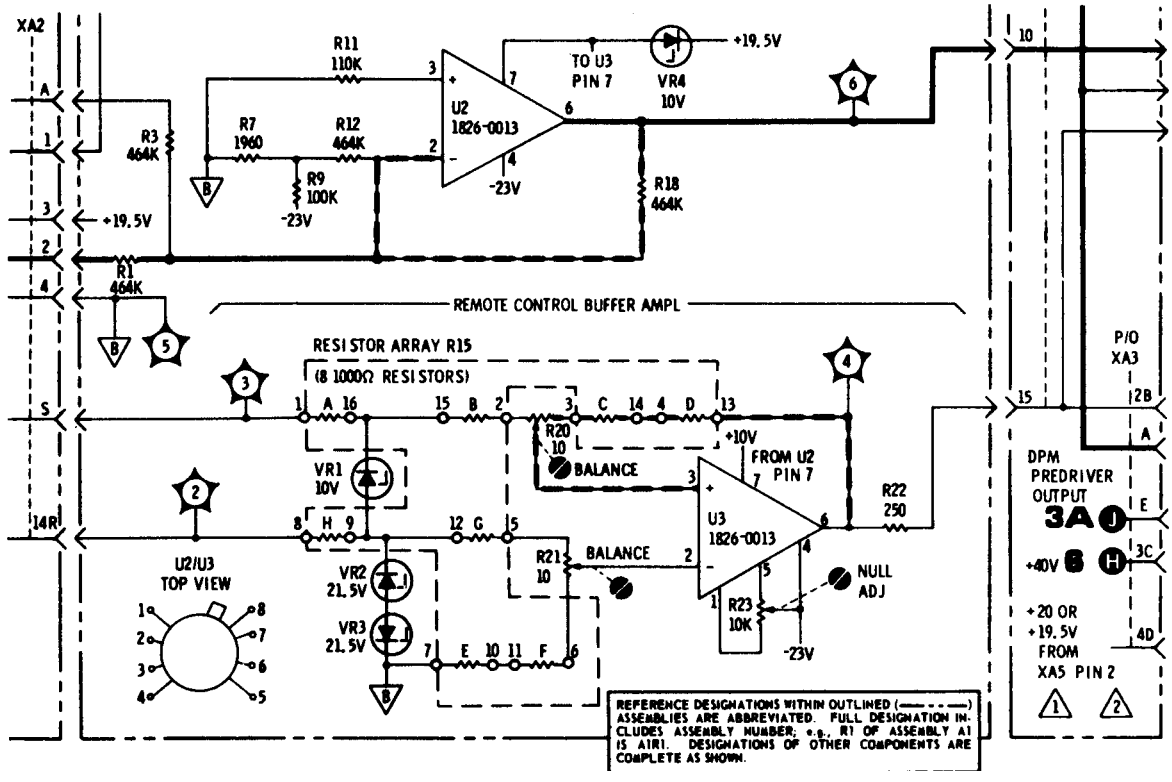


Figure 7-3. Partial schematic correction for Service Sheet 5. (P/O CHANGE C)

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for troubleshooting and repair of the HP 8445B Automatic Preselector. It includes general servicing hints and information, simple block diagrams with a brief discussion of common Preselector systems, a Troubleshooting Block Diagram with an accompanying trouble isolation procedure, assembly photographs with component identifications, and Service Sheets, each with circuit explanations and servicing information.

WARNING

Line voltage is always present on terminals including the power input connector, fuse holder, power switch, etc. In addition, when the instrument is on, energy available at many points may result in personal injury or death when contacted.

8-3. ASSEMBLY SERVICE SHEETS

8-4. The schematics are arranged by service sheets. The service sheet numbers appear in the lower righthand corner of schematics (large number above assembly number). Included in the service sheet is the schematic as well as the accompanying circuit theory, component parts location photo, and schematic-level troubleshooting. A list of foldouts, diagrams and service sheets cross--referenced to assemblies is given in Table 8-1. Bold number-letter combinations, such as **A3**, indicate Service Sheet and lettered circuit points of interconnection. Numbers in black squares, such as 4, indicate circuits discussed in theory of operation and in troubleshooting procedures.

8-5. PRINCIPLES OF OPERATION

8-6. Information relative to general principles of Preselector operation with common options is included with the simplified block diagrams of Figures 8-4 and 8-5. Additional circuit descriptions in a more detailed form are given in the individual Service Sheets.

8-7. TROUBLESHOOTING

8-8. Servicing the Preselector is made easier by the inclusion of general service hints and information, plus a simplified block diagram of possible Preselector systems with test points useful in isolating troubles in a simple step-by-step method to determine a faulty assembly. When a faulty assembly is indicated, reference is made to the Service Sheet where isolation to the faulty component is explained.

8-9. RECOMMENDED TEST EQUIPMENT

8-10. Test equipment and accessories required to maintain the Preselector are listed in Table 1-5. If the equipment listed is not available, equipment that meets the required specifications may be substituted.

8-11. REPAIR

8-12. Rigid Cables.

8-13. If necessary to loosen or remove rigid RF cables between filters, coaxial switches and panel connectors, care must be taken not to alter their shape. Bending may affect electrical characteristics of the cables.

8-14. Cleaning Switches

8-15. Front panel and board-mounted switches may be cleaned without removal. The cleaning agent recommended is isopropyl alcohol, HP Part No. 8500-0755. Spray the solvent into the switch while sliding the switch back and forth. Repeat the procedure several times. Continue to slide the switch until the solvent is evaporated.

Table 8-1. Foldouts-Assemblies-Photographs Cross-referenced

Foldouts	Assemblies Involved	Assembly Photographs
Simplified Block Diagrams	A1, A2, A3, A4, A7	
SERVICE SHEET 1 Troubleshooting Flow Diagram Comprehensive Block Diagram	A1, A2, A3, A4, A7	
SERVICE SHEET 2 YIG Predriver	A1 (Standard)	A1 (Standard)
SERVICE SHEET 3	A1 (Opt. 003)	A1 (Opt. 003)
SERVICE SHEET 4 YIG Driver	A3, A4	A3
SERVICE SHEET 5 Power Supply and Switching	A2, A3, A4	A2
SERVICE SHEET 6 Power Supply and Module	A2, A6	A2
Adjustment Controls		A1 (Standard) A1 (Opt.003) A2, A3

8-16. GENERAL SERVICE HINTS

8-17. Etched Circuit Boards

8-18. The etched circuit boards used in Hewlett-Packard equipment are the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The circuit boards can be either a single layer or multi-layer board. The metallic conductors are extended through the component holes or interconnect holes by a plating process. Soldering can be performed on either side of the board with equally good results. Table 8-3 lists recommended tools and materials for use in repairing etched circuit boards. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

c. Use a suction device or wooden toothpick to remove solder from component mounting holes.

CAUTION

Do not use a sharp metal object such as an awl or twist drill for this purpose. Sharp objects may damage the plated-through conductor.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion.

Table 8-2. Schematic Diagram Notes

SCHEMATIC DIAGRAM NOTES

Refer to ANSI Y32.2

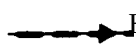
R, C, L	Resistance is in ohms, capacitance is in microfarads, and inductance in millihenries unless otherwise noted.
P/O	Part Of
*	Asterisk, on component denotes a factory-selected value. Value shown is typical. Capacitors may be omitted or resistors jumpered.
	Screwdriver adjustment.
	Panel control.
	Encloses front panel designation.
	Encloses rear panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
	Numbered test point. Measurement terminal provided.
	Lettered Test Point. No measurement terminal provided.
	Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower stripe, e.g. (947) denotes white base, yellow wide stripe, violet narrow stripe.
n=1±*	n = harmonic number 1 = 1st LO fundamental ± = 1st LO above or below 1st IF * = 550 MHz 1st IF; no asterisk = 2050 MHz 1st IF.
	Letter = off page connection. Number = Service Sheet location for off page connection.
	Chassis ground
	Assembly ground

Table 8-3. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering	Soldering Unsoldering	Wattage rating: 47½ - 56½ Tip Temp: 850 - 900 degrees	Ungar No. 776 handle with *Ungar No. 4037 Heating Unit
Soldering* tip	Soldering Unsoldering	*Shape: pointed	*Ungar No. PL111
De-soldering aid	To remove molten solder from connection	Suction device	Soldapult by Edsyn Co., Arleta, California
Resin (flux)	Remove excess flux from soldered area before ap plication of protective coating	Must not dissolve etched base board material or conductor bonding agent	Freon, Aceton, Lacquer Thinner, Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective coating	Contamination, corro-sion protection	Good electrical insulation, corrosion-prevention pro-perties	Silicone Resin such as GE DRI-FILM** 88

*For working on etched boards; for general purpose work, use Ungar No. 1237 Heating Unit (37.5W, tip temperature of 750—800 degrees) and Ungar No. PL113, 1/8 inch chisel tip.

**General Electric Co., Silicone Products Dept., Waterford, New York, U.S.A.

8-19. Component Replacement

8-20. The following procedures are recommended when component replacement is necessary:

a. Remove defective component from board.

b. If component was unsoldered, remove solder from mounting holes with a suction device or a wooden toothpick.

c. Shape leads of replacement component to match mountig hole spacing.

d. Insert component leads into mounting holes and position component as original was positioned. Do not force leads into mounting holes: sharp lead ends may damage the plated-through conductor.

NOTE

Although not recommended when both sides of the circuit board are accessible, axial lead components such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

8-21. GENERAL SERVICE INFORMATION

8-22. Transistors and Diodes

8-23. Transistors and diodes are used throughout the Preselector in circuit configurations such as delay circuits, trigger circuits, switches, oscillators and various types of amplifiers. Basic transistor operation is shown in the following pages.

8-24. Transistor In-Circuit Testing. The common causes of transistor failure are internal short circuits and open circuits. In transistor circuit testing, the most important consideration is the transistor base-to-emitter junction. The base emitter junction in a transistor is comparable to the control grid-cathode relationship in a vacuum tube. The base emitter junction is essentially a solid-state diode; for the transistor to conduct, this diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Transistor symbols on schematic diagrams reveal the bias polarity required to forward-bias the base-emitter junction. The B part of Figure 8-1 shows transistor symbols with the terminals labeled. The other two columns compare the biasing required to cause conduction and cut-off in NPN and PNP transistors. If the transistor base-emitter junction is forward biased, the transistor conducts. However, if the base-emitter junction is reverse-biased, the transistor is cut off (open). The voltage drop across a forward-biased, emitter-base junction varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2 - 0.3 volt when collector current is 1 - 10 mA, and 0.4 - 0.5 volt when collector current is 10 - 100 mA. In contrast, forward-bias voltage for silicon transistors is about twice that for germanium types; about 0.5 - 0.6 volt when collector current is low, and about 0.8 - 0.9 volt when collector current is high.

8-25. Figure 8-1, Part A, shows simplified versions of the three basic transistor circuits and gives the characteristics of each. When examining a transistor stage, first determine if the emitter-base junction is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure each voltage separately with respect to a common point (e.g., chassis). If the emitter-base junction is forward-biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then change and approach the supply voltage. Any difference is due to leakage current through the transistor and, in general, the smaller this current the better the transistor. If the collector voltage does not change, the transistor has either an emitter-collector short circuit or emitter-base open circuit.

8-26. Transistor and Diode Markings. Figure 8-2 illustrates examples of diode and transistor marking methods. In addition, the emitter lead for bipolar transistors is identified on the printed circuit boards.

8-27. Printed Circuit Board Markings. On the printed circuit board, a square pad is etched around one pin of some components to show how the component must be installed when replacement is made. The square pad indicates the following:

a. The cathode of a diode

b. Emitter of a transistor

c. Source of an FET

d. Pin one of an integrated circuit

e. Pin one of an integrated circuit socket

f. Pin one of a cable connector

8-28. Operational Amplifiers

8-29. Operational Amplifiers Function. Operational amplifiers are used to provide such functions as summing amplifiers, offset amplifiers, buffers and power supplies. The particular function is determined by the external circuit connections. Equivalent circuit and logic diagrams for type 741 operational amplifiers are contained in Figure 8-3. Circuit A is a non-inverting buffer amplifier with a gain of 1. Circuit B is a non-inverting amplifier with gain determined by the resistance of R1 and R2. Circuit C is an inverting amplifier with gain determined by R1 and R2. Circuit D contains the functional circuitry and pin connection information along with an operational amplifier review.

NOTE

In Circuit D it is assumed that the amplifier has high gain, low output impedance and high input impedance.

8-30. Operational Amplifier Troubleshooting Procedure. When operational amplifiers are suspected, one quick check is case temperature, which should not be hot to the touch. If the output voltage approaches or equals either the negative or positive bias supply values the device should be suspected. Measure and record the voltage level at both the - (inverting) terminal pin 2 and the + (noninverting) terminal pin 3. The levels should not differ by more than = 10 mV. If the voltage levels are not within ≅= 10 mV, check the external circuitry and components. If the external circuitry (input signal, operating voltages, feedback resistors) appears normal, replace the operational amplifier.

8-31. ELECTRICAL MAINTENANCE

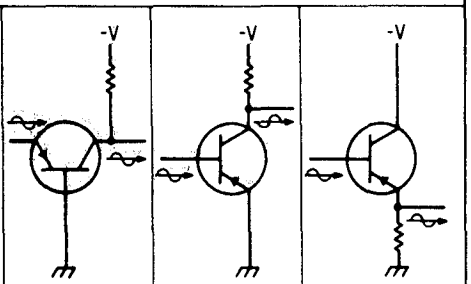
8-32. Perform the electrical checks and adjustments periodically and after repair or component replacement.

8-33. MECHANICAL MAINTENANCE

8-34. Inspect the air filter at the rear of the instrument frequently and clean it before air flow is restricted. To clean the filter, wash thoroughly in warm water and detergent. Air dry filter before installing it on the instrument.

A

Amplifier Characteristics



CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
Input Impedance	30Ω - 50Ω	500Ω - 1500Ω	20KΩ - 500KΩ
Output Impedance	300KΩ -500KΩ	30KΩ - 50KΩ	50Ω - 1000Ω
Voltage Gain	500 - 1500	300 - 1000	<1
Current Gain	<1	25 - 50	25 - 50
Power Gain	20 dB - 30 dB	25 dB - 40dB	10 dB - 20 dB (Emitter Follower)

B

Transistor Biasing

TYPE	CUTOFF	CONDUCTION
NPN COLLECTOR BASE EMITTER	+V 0V	+V MAIN CURRENT +V CONTROL CURRENT
PNP COLLECTOR BASE EMITTER	-V 0V	-V -V CONTROL CURRENT MAIN CURRENT

Figure 8-1. Transistor Characteristics and Biasing.

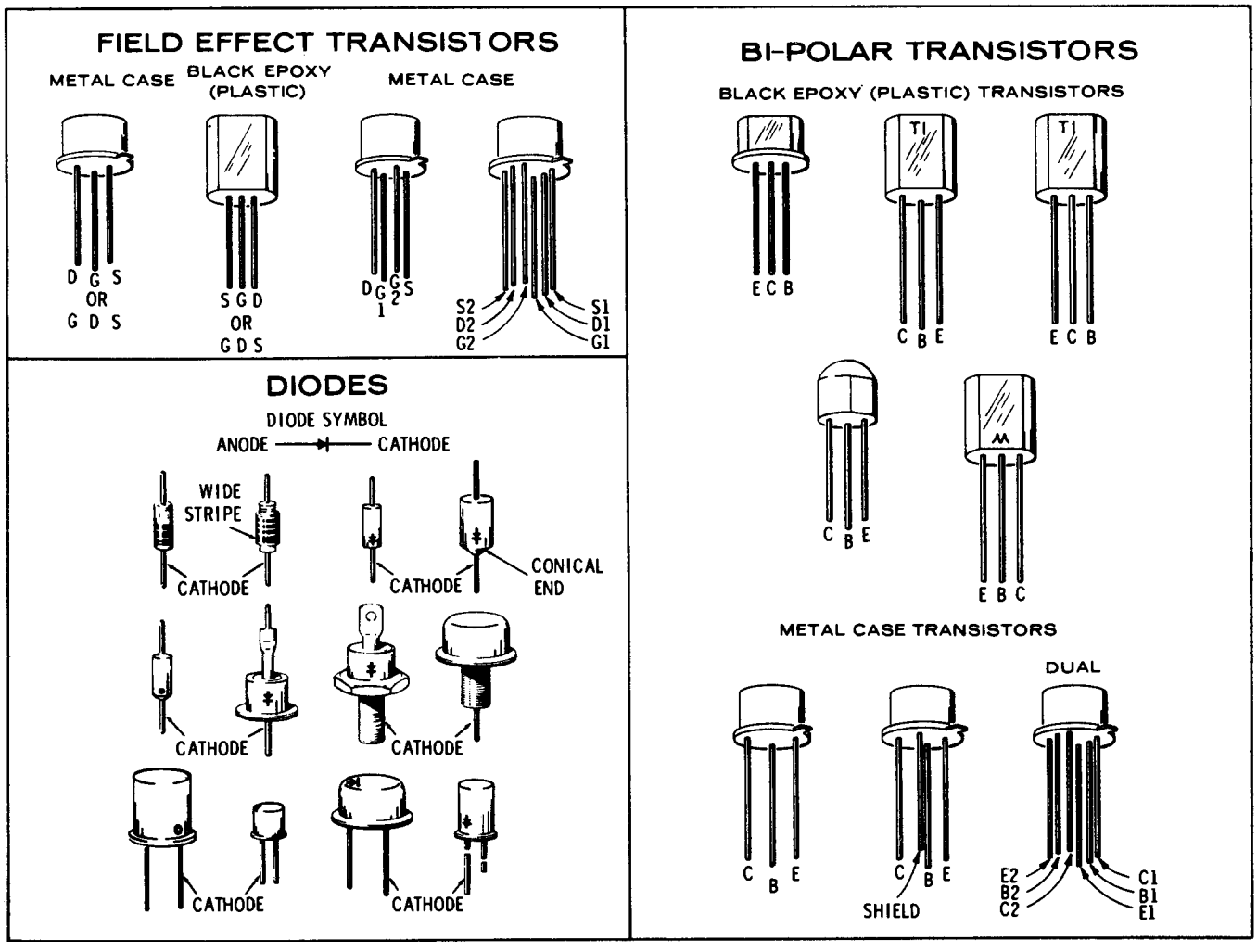


Figure 8-2. Examples of Diode and Transistor Marking Methods

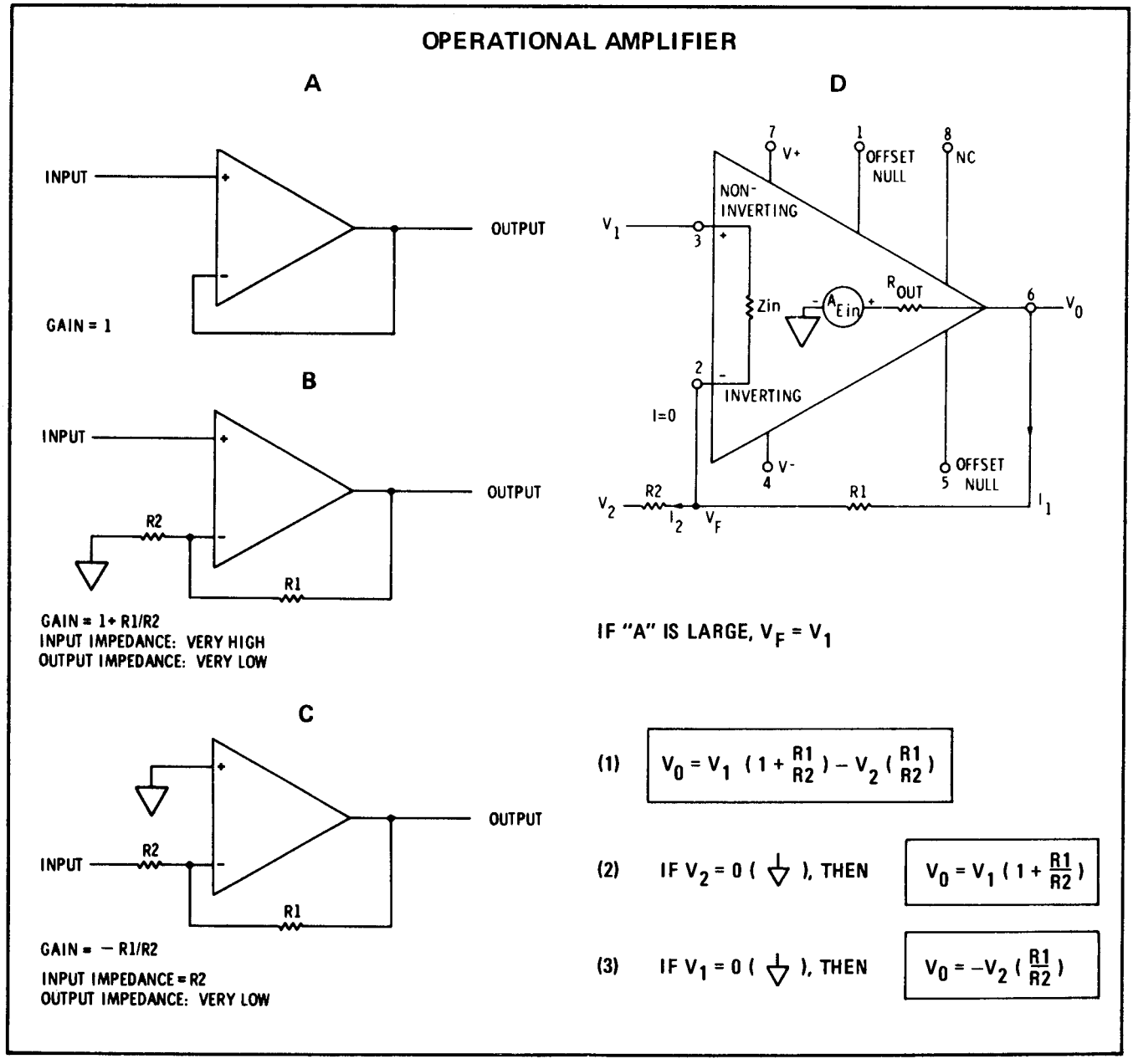


Figure 8-3. Operational Amplifier Equivalent Circuit

AUTOMATIC PRESELECTOR SYSTEMS

1. STANDARD PRESELECTOR MODELS

The shaded blocks in Figure 8-5 represent a simplified block diagram of a Standard Model 8445B Automatic Preselector. To use the 8445B YIG filter as a stand-alone 1.8 to 18 GHz narrow band-pass filter, an external tuning voltage of + 1.8 to +18 V can be applied to the rear panel BNC connector J4 (Figure 8-4) marked REMOTE. The center frequency of the nominally 30 MHz-wide filter will follow the remote tuning voltage according to a 1 GHz/V relationship. The tuned resonant effect of the YIG filter is controlled by the value of dc current fed to its tuning coil (electromagnet). Tuning sensitivity is approximately 26 mA/GHz. In the Standard Model, operation is selected automatically if the 8445 is not connected to an 8555A RF Section.

When operating as a preselector for an 8555A RF Section Spectrum Analyzer, the RF OUTPUT of the 8445B is connected to the INPUT of the 8555A by rigid cable, W1.

The YIG Pre-Driver uses input voltages from the 8555A Spectrum Analyzer System and produces an output voltage that is proportional to the frequency to which the analyzer is tuned. The analyzer provides a Sweep + Tune voltage that is representative of the frequency of the YIG oscillator in the analyzer. This voltage varies linearly from -5.000 volts for a LO frequency of 2.050 GHz to -10.000 volts for a LO frequency of 4.100 GHz. The Sweep + Tune voltage is applied to a harmonic number amplifier in the Preselector. The gain of the harmonic amplifier is controlled by Band Code signals "A" and "B" from the analyzer. Band Code bits "A" and "B" represent the frequency bands n = 1 through n = 4. The output from the harmonic number amplifier is a voltage representative of LO harmonic frequency. The frequency-to-voltage ratio is 1.025 GHz/Volt. The output from the harmonic amplifier is applied to a summing amplifier where it is combined with the IF offset voltage. Band Code bit "E" from the analyzer is applied to the n = + or – mixing offset amplifier in the Preselector. The + or – mixing offset amplifier provides an offset voltage to match the mixing mode in the analyzer. The output from the offset amplifier is applied through a 2.05 GHz IF or 550 MHz IF offset network to the summing amplifier. The IF offset is a resistive network controlled by Band Code bit "D" from the analyzer. The output is a voltage proportional to the analyzel's 1st IF offset. The frequency-to-voltge ratio is 1.025 GHz/Volt. The Summing Amplifier combines the output of the Harmonic Number Amplifier with the output from the 2.05 GHz/550 MHz IF Offset Network to produce an output voltage level to the YIG Driver that is proportional to the frequency to which the analyzer is tuned. The Summing Amplifier has unity gain (– 1) with an output voltage level proportional to frequency by a ratio of 1.025 GHz/volt.

Standard 8445B models utilize Band Code bits A, B, D, and E from the 8555A to automatically switch the LP filter (Figure 8-4) in place of the tunable YIG filter in the Preselector RF signal line when the 0-2.0 GHz band is selected.

The front panel FREQ OFFSET adjustment is used to trim the YIG filter magnet current to correct for slight variations in filter frequency. The screwdriver TRACKING adjustment is used if the Preselector is not tracking properly en low and high frequency bands. (See Paragraph 5-13.)

2. OPTION 004 MODELS

When Option 004 is ordered, the 1.8 GHz low-pass filter and the coaxial switching relays are deleted. The Coaxial Switch Control and Driver circuitry are retained on the A2 Power Supply assembly for possible future use.

3. OPTION 003 MODELS

When Option 003 is ordered, the Al Predriver, shown shaded in Figure 8-5, is replaced with one containing both the shaded and unshaded circuits. In addition, a complete digial panel meter circuit is mounted behind a window on the front panel of the Preselector (Figure 8-11). The 8555A supplies a -7.5 V to -15 V TUNE voltage from its YIG-tuned LO Driver. This voltge is processed in a manner similar to the SWEEP+ TUNE voltge in the Standard Model, except that the output of the DPM section Summing Amplifier converts the TUNE voltage to a 1.025 GHz/V level fed to the DPM. The digital meter is a voltmeter with a resistive voltage divider input to convert the 1.025 GHz/V to a 1GHz/V level.When the 8555A is tuned to a frequency of 3 GHz, for example, the Summing Amplifier output is 3 x 0.976 or 2.927 V, resulting in a display reading of 3.000 GHz. If the Preselector is tracking properly, the frequency being displayed is also the center frequency of the YIG filter pass band.

4. OPTION 002 MODELS

Option 002 adds a MODE switch with AUTOmatic, REMOTE, LOW-PASS, and MANUAL positions, plus COARSE and FINE manual tuning controls on the front panel of the Preselector (Figure 8-4 and unshaded circuitry of Figure 8-6). In the AUTO position the Preselector operates as a Standard Model. In the REMOTE position the YIG filter is tuned by a 1 GHz/V voltage applied to the REMOTE input BNC connector on the rear panel of the Preselector. In the LOW-PASS position the 1.8 GHz low-pass filter is connected in place of the YIG filter in the Preselector RF line. In the MANUAL position the YIG filter can be used as a stand-alone 1.8 to 18 GHz filter tuned manually with the COARSE and FINE manual tuning dials to any selected frequency in this band. If a Preselector has both Option 002 and Option 003, in the AUTO switch position with the Spectrum Analyzer off, or with the interconnect cable W3 disconnected, the DPM will read 2050.

5. COMPREHENSIVE MODELS

The 8445B Automatic Preselector may incorporate both Options 002 and 003. In this case the unshaded DPM circuits of Figure 8-5 would be added to the circuits shown in Figure 8-6. Such a comprehensive system is diagramed in the Comprehensive Block Diagram of Figure 8-8.

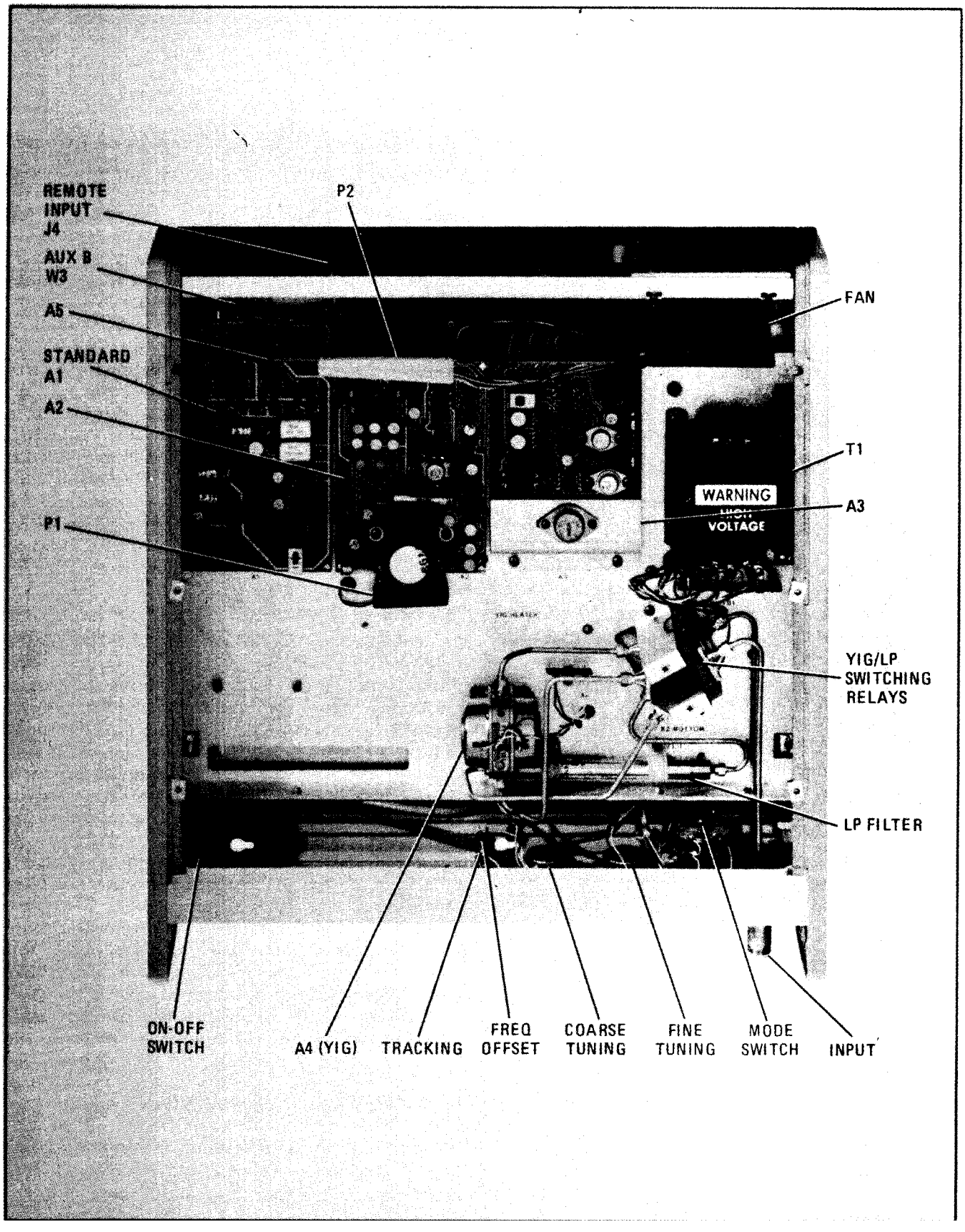
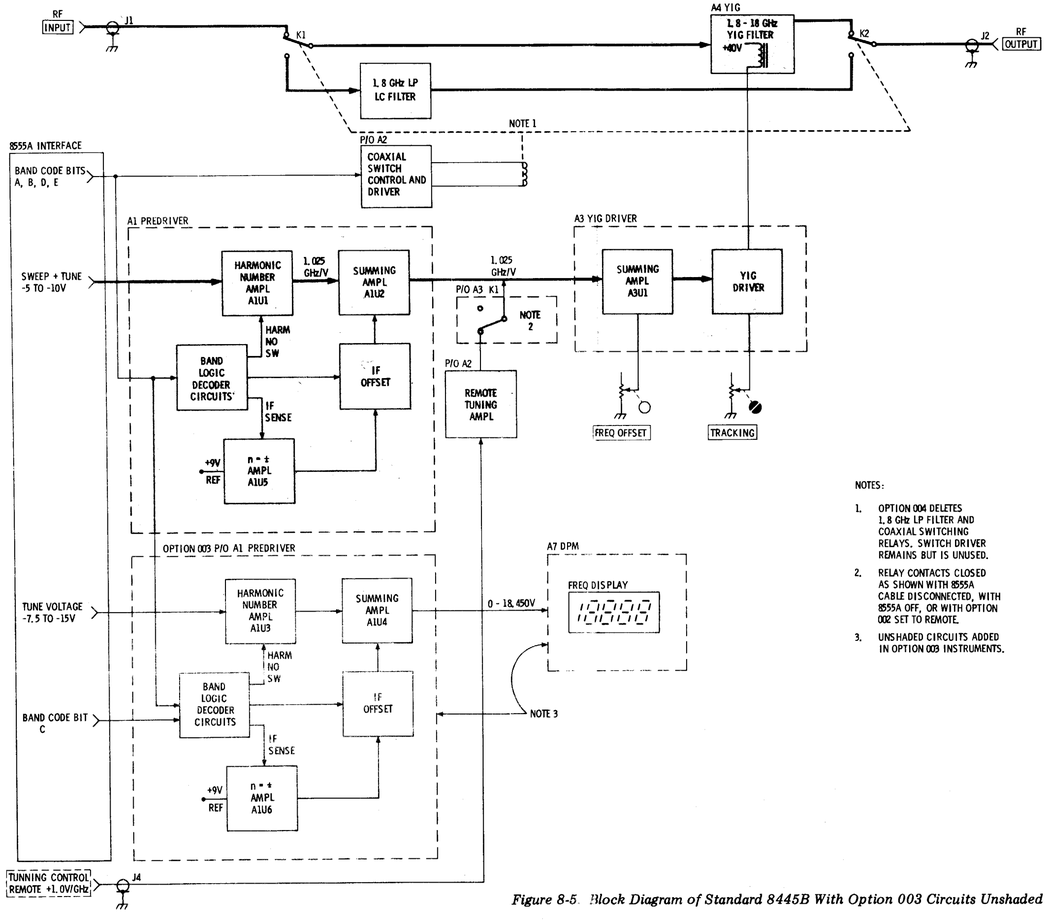


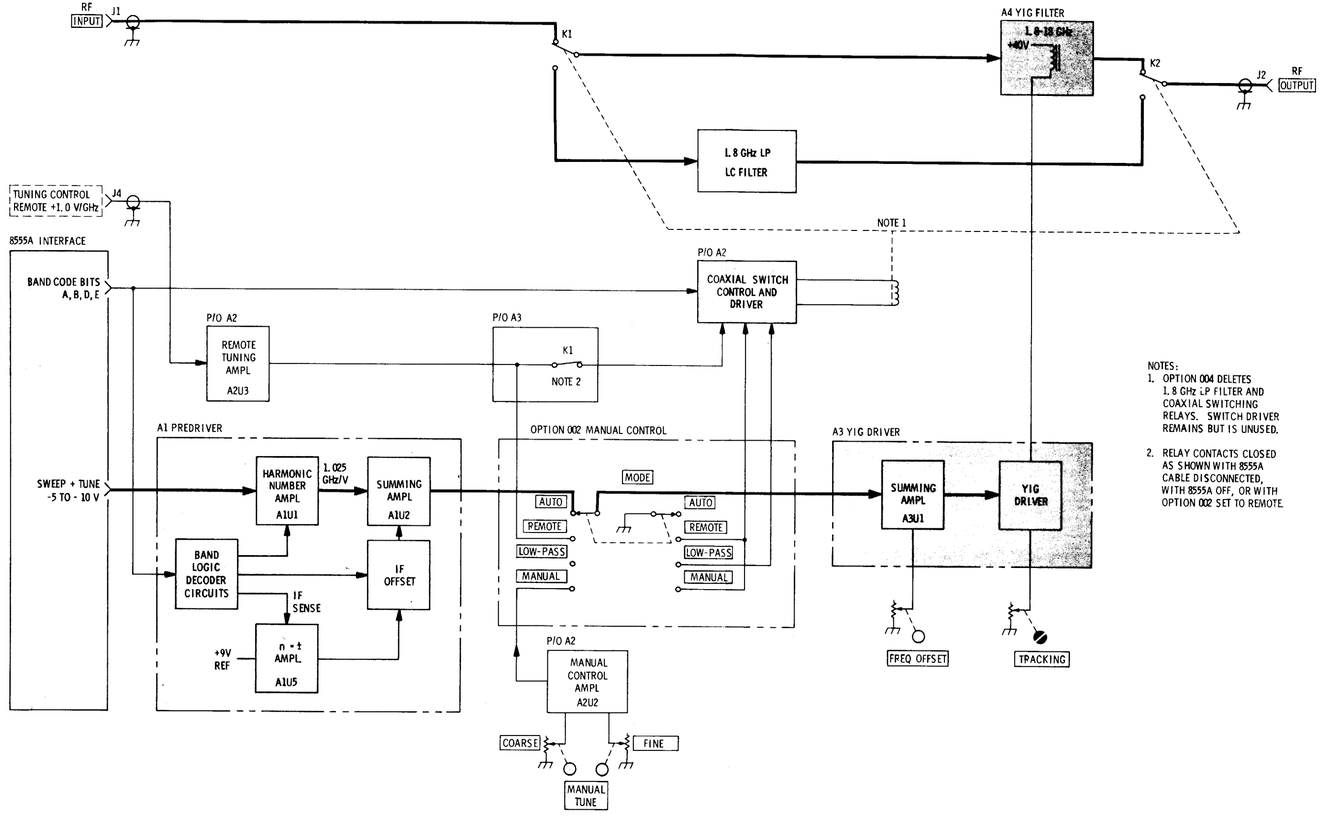
Figure 8-4. Top View of 8445B With Option 002 Panel Switches and Controls



NOTES:

1. OPTION 004 DELETES 1.8 GHz LP FILTER AND COAXIAL SWITCHING RELAYS. SWITCH DRIVER REMAINS BUT IS UNUSED.
2. RELAY CONTACTS CLOSED AS SHOWN WITH 8555A CABLE DISCONNECTED, WITH 8555A OFF, OR WITH OPTION 002 SET TO REMOTE.
3. UNSHADED CIRCUITS ADDED IN OPTION 003 INSTRUMENTS.

Figure 8-5. Block Diagram of Standard 8445B With Option 003 Circuits Unshaded



NOTES:

1. OPTION 004 DELETES 1.8 GHz LP FILTER AND COAXIAL SWITCHING RELAYS. SWITCH DRIVER REMAINS BUT IS UNUSED.
2. RELAY CONTACTS CLOSED AS SHOWN WITH 8555A CABLE DISCONNECTED, WITH 8555A OFF, OR WITH OPTION 002 SET TO REMOTE.

Figure 8-6. Block Diagram of 8445B With Option 002 Circuits Unshaded

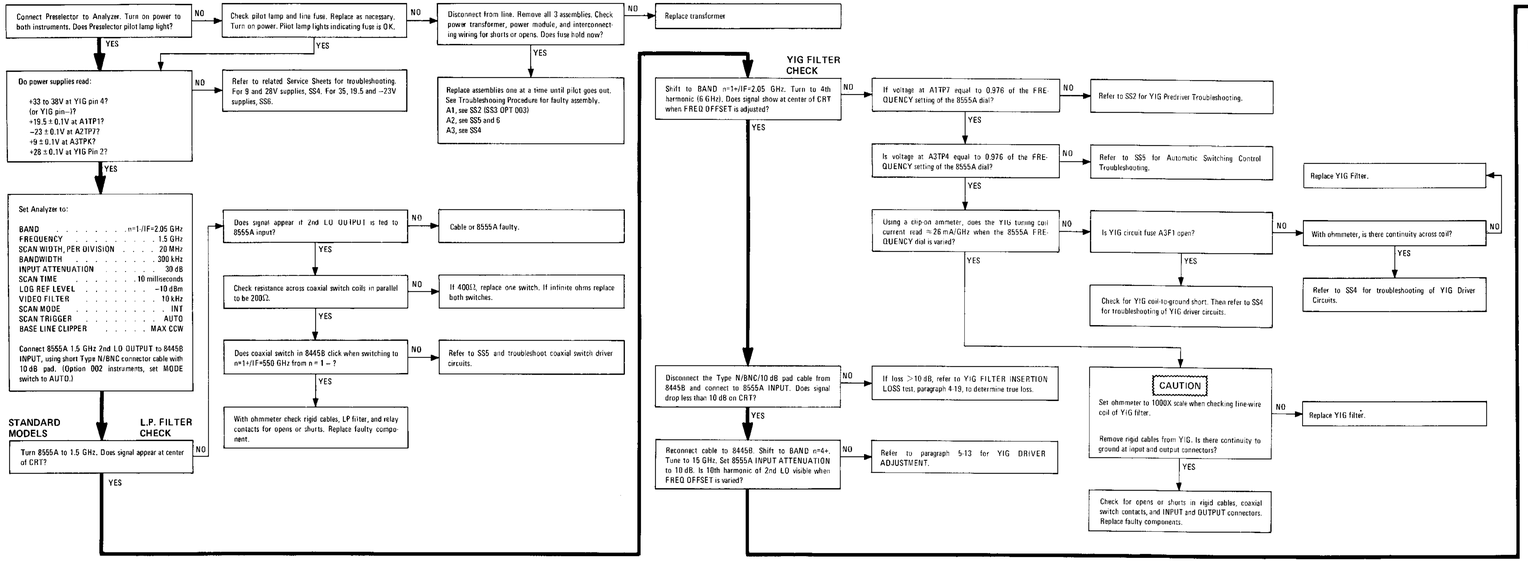

Connect Preselector to Analyzer. Turn on power to both instruments. Does Preselector pilot lamp light?
NO
Check pilot lamp and line fuse. Replace as necessary. Turn on power. Pilot lamp lights indicating fuse is OK.
NO
Disconnect from line. Remove all 3 assemblies. Check power transformer, power module, and interconnecting wiring for shorts or opens. Does fuse hold now?
NO
Replace transformer
YES
YES
YES
Do power supplies read:
+33 to 38V at YIG pin 4?
(or YIG pin-1?
+19.5 ± 0.1V at A1TP1?
−23 ± 0.1V at A2TP7?
+9 ± 0.1V at A3TPK?
+28 ±0.1V at YIG Pin 2?
NO
Refer to related Service Sheets for troubleshooting. For 9 and 28V supplies, SS4. For 35, 19.5 and −23V supplies, SS6.
Replace assemblies one at a time until pilot goes out. See Troubleshooing Procedure for faulty assembly.
A1, see SS2 (SS3 OPT 003)
A2, see SS5 and 6
A3, see SS4
YES
Set Analyzer to:
BAND . . . . . n=1-/IF=2.05 GHz
FREQUENCY . . . . . 1.5 GHz
SCAN WIDTH, PER DIVISION . . . . 20 MHz
BANDWIDTH . . . . . 300 kHz
INPUT ATTENUATION . . . . . 30 dB
SCAN TIME . . . . . 10 milliseconds
LOG REF LEVEL . . . . . −10 dBm
VIDEO FILTER . . . . . 10 kHz
SCAN MODE . . . . . INT
SCAN TRIGGER . . . . . AUTO
BASE LINE CLIPPER . . . . . MAX CCW
Connect 8555A 1.5 GHz 2nd LO OUTPUT to 8445B INPUT, using short Type N/BNC connector cable with 10 dB pad. (Option 002 instruments, set MODE switch to AUTO.)
Does signal appear at 2nd LO OUTPUT is fed to 8555A input?
NO
Cable or 8555A faulty.
YES
Check resistance across coaxial switch coils in parallel to be 200Ω.
NO
If 400Ω, replace one switch. If infinite ohms replace both switches.
YES
Does coaxial switch in 8445B click when switching to n=1+/IF=550 GHz from n = 1 – ?
NO
Refer to SS5 and troubleshoot coaxial switch driver circuits.
YES
With ohmmeter check rigid cables, LP filter, and relay contacts for opens or shorts. Replace faulty component.
STANDARD MODELS
L.P. FILTER CHECK
Turn 8555A to 1.5 GHz. Does signal appear at center of CRT?
NO
YES
YIG FILTER CHECK
Shift to BAND n=1+/IF=2.05 GHz. Turn to 4th harmonic (6 GHz). Does signal show at center of CRT when FREQ OFFSET is adjusted?
NO
If voltage at A1TP7 equal to 0.976 of the FREQUENCY setting of the 8555A dial?
NO
Refer to SS2 for YIG Predriver Troubleshooting.
YES
Is voltage at A2TP4 equal to 0.976 of the FREQUENCY setting of the 8555A dial?
NO
Refer to SS5 for Automatic Switching Control Troubleshooting.
YES
Using a clip-on ammeter, does the YIG tuning coil current read ≈ 26 mA/GHz when the 8555A FREQUENCY dial is varied?
NO
Is YIG circuit fuse A2F1 open?
NO
With ohmmeter, is there continuity across coil?
NO
Replace YIG Filter.
YES
Check for YIG coil-to-ground short. Then refer to SS4 for troubleshooting of YIG driver circuits.
YES
Refer to SS4 for troubleshooting of YIG Driver Circuits.
YES
Disconnect the Type N/BNC/10 dB pad cable from 8445B and connect to 8555A INPUT. Does signal drop less than 10 dB on CRT?
NO
If loss >10 dB, refer to YIG FILTER INSERTION LOSS test, paragraph 4-19, to determine true loss.
CAUTION
Set ohmmeter to 1000X scale when checking fine-wire coil of YIG filter.
Remove rigid cables from YIG. Is there continuity to ground at input and output connectors?
NO
Replace YIG filter.
YES
Check for opens or shorts in rigid cables, coaxial switch contacts, and INPUT and OUTPUT connectors. Replace faulty components.
YES
Reconnect cable to 8445B. Shift to BAND n=4+. Tune to 15 GHz. Set 8555A INPUT ATTENUATION to 10 dB. Is 10th harmonic of 2nd LO visible when FREQ OFFSET is varied?
NO
Refer to paragraph 5-13 for YIG DRIVER ADJUSTMENT.
YES
MANUAL
OPTION 002
Set MODE switch to MANUAL: Set FINE MANUAL TUNE to 0. When COARSE MANUAL TUNE is varied is voltage at A2TP6 0.976 of dial reading in GHz?
NO
Refer to SS5 for MANUAL amplifier circuit troubleshooting.
YES
Does YIG tuning coil current read ≈ 26 mA/GHz when COARSE MANUAL TUNE is tuned?
NO
Refer to SS1 and SS5. Check MODE switch wiring from A1 to A3 for opens or shorts. Troubleshoot A2 Coaxial Switch Driver.
YES
REMOTE
Standard models remove W3 Option 002. Set Mode Switch to Remote. Does voltage at A2TP4 read 0.976 of +0.1 to +18V applied to REMOTE INPUT?
NO
Refer to SS5 for REMOTE amplifier circuit troubleshooting.
YES
Does YIG tuning coil current read ≈ 26 mA/GHz when remote power supply is tuned?
NO
Refer to SS1 and SS5. Check MODE switch wiring from A2 to A3 for opens or shorts.
YES
LOW-PASS FILTER
OPTION 002
Set MODE switch to LOW-PASS. Tune 8555A to 1.5 GHz. Signal should appear on center CRT?
NO
Refer to SS1 and SS5. Check MODE switch wiring between switch and A2 for opens or shorts.
YES
DIGITAL DISPLAY
OPTION 003
Set 8555A to 10 GHz. DPM should read within 20 MHz of this value.
NO
Refer to SS3 for troubleshooting DPM circuits.
YES
Troubleshooting complete. Unit is operating normally.

Figure 8-7. Troubleshooting Flow Diagram

SERVICE SHEET 1

TROUBLESHOOTING

General

The 8445B Automatic Preselector simplified Comprehensive Block Diagram of Figure 8-8 includes interconnections for a Standard Model incorporating Options 002, 003, and 004.

A malfunction in the Preselector or interconnecting cable can affect operation of the Spectrum analyzer, or a malfunction in the Spectrum Analyzer can affect Preselector operation. Before troubleshooting either instrument make sure the analyzer is operating correctly. If the Preselector does not appear to function properly when connected to the Spectrum Analyzer, take the following preliminary corrective steps: Remove interconnect cable, replace firmly and lock into position. Remove IF and RF Sections, decouple from each other then recouple carefully. Mate IF/RF sections into main frame firmly and lock into position. Make sure the 102-120-220-240 V power module printed circuit card is in the proper position for the line voltage being used. If proper operation does not now result, a logical trouble isolation procedure should be employed. Usually malfunction isolation should utilize the operation capability of the Preselector as far as possible. Preselectors can be checked with the 2nd LO OUTPUT of the 8555A and harmonics of this 1.5 GHz signal. Units may be checked by remotely tuning the Preselector with a positive dc voltage of 1 GHz/V applied to the REMOTE input. Units with manual controls can be switched to MANUAL operating mode to tune them over the same range with front panel controls.

A simple check for normal test-point voltages may quickly isolate a malfunction to one assembly. Operate the Standard Preselector (or Option 002 in AUTO mode) with both internal assembly test switches at OPR and the 8555A set to BAND n=2—. With a dc voltmeter check for the following approximate voltages:

Test Points	Normal Voltages
A1TP1	−5.0 to −10.0 V, 8555A L O tuned from 2.05 to 4.1 GHz.
A1TP2	+3.8 to +7.8 V, when L O tuned from 2.05 to 4.1 GHz.
A1TP5	−9 V on n = X− bands, +9 V on n = X+.
A1TP7	−1.7 to −5.8 V when L O tuned from 2.05 to 4.1 GHz.
A1TP3	(Option 003) −6.3 to −15 V when L O tuned 2.05 to 4.1 GHz.
A1TP4	(Option 003) +3.8 to +7.8 V when L O tuned 2.05 to 4.1 GHz.
A1TP6	(Option 003) −9 V on n = X− bands, +9 V on n = X− bands.
A1TP8	(Option 003) −1.7 to −5.8 V when L O tuned 2.05 to 4.1 GHz.
A2TP1	+19.5 V supply.
A2TP2 to A2TP3	The remote control voltage value.
A2TP4	With +2.0 V to REMOTE, −1.95 V.
A2TP5	Ground point.
A2TP6	With COARSE TUNING set to 2.0 GHz, −1.95 V.
A2TP7	−23 V supply.
A2TPE	Approx. +29 to +8V when switching to BAND n = 1−/IF = 2.05 GHz.
A2TPF	Approx. +2 to +34 V when switching to BAND n = 1−/IF = 2.05 GHz.
A2TPG	Approx. +35 V at 0 GHz, +31 V at 18 GHz.
A3TP1	+19.5 V.
A3TP2	Reference ground point.
A3TP3	Approx. +0.01 V at 0 GHz, +1.7 V at 18 GHz.
A3TP4	−1.7 to −5.8 V when L O tuned 2.05 to 4.1 GHz.
A3TPF	Approx. +35 V at 0 GHz, +28 V at 18 GHz.
TB2-9	(White wire) +28 V YIG heater supply.

The Troubleshooting Flow Diagram, Figure 8-7, represents a more detailed troubleshooting procedure which may be followed.

Equipment needed:

Multi-Function Meter	HP 427A
Clip-on Milliammeter	HP 428B

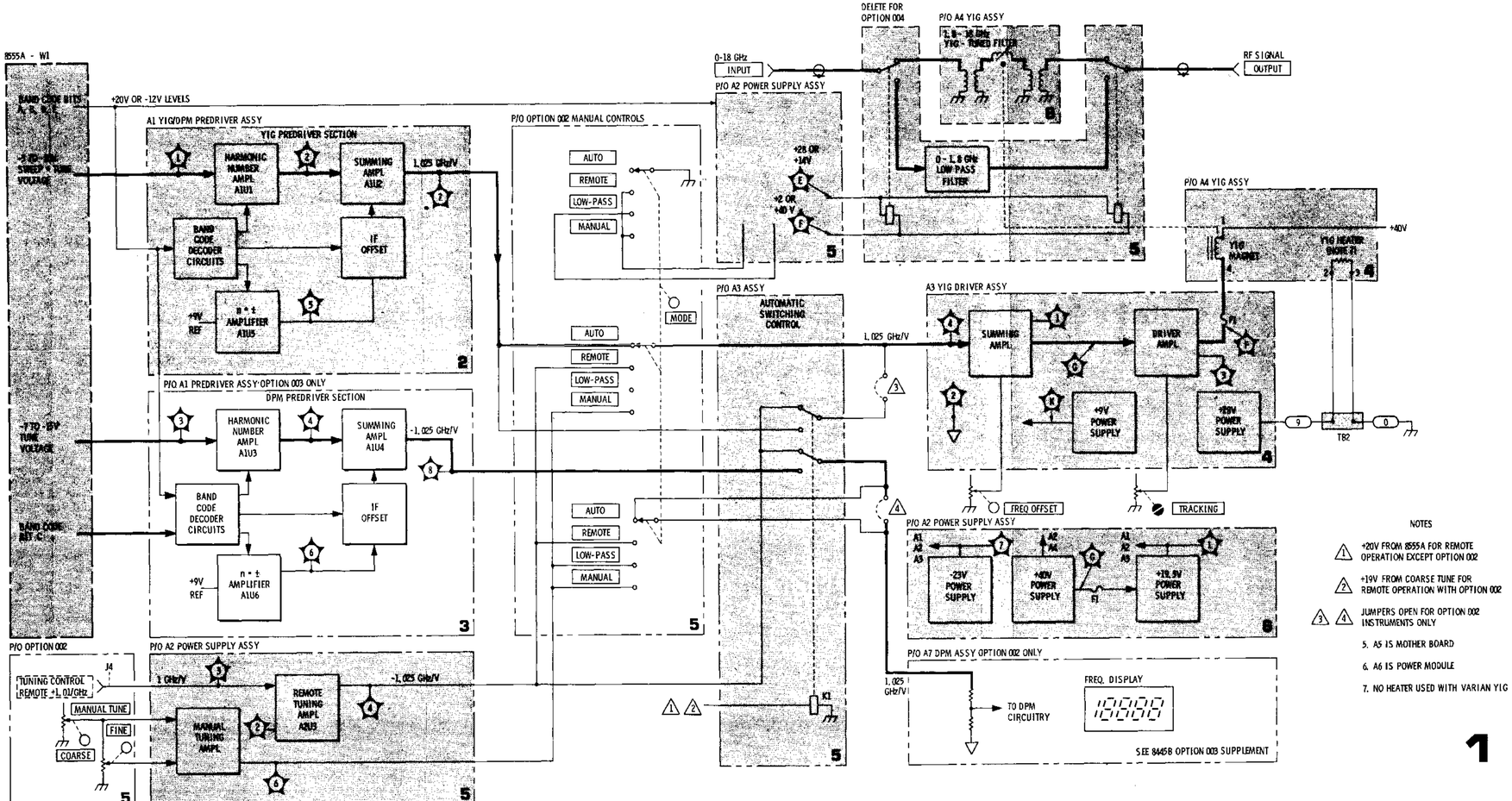


Figure 8-8. Comprehensive Block Diagram Including Options 002 and 003

SERVICE SHEET 2

A1 PRE-DRIVER ASSEMBLY

Service Sheet 2 includes the schematic diagram, the theory of operation, and basic troubleshooting procedures for the Pre-driver Assembly A1 used in all 8445B Automatic Preselectors. The Pre-driver converts Sweep+Tune voltage from the 8555A to a voltage that is proportional to the frequency to which the RF Section is tuned.

PRINCIPLES OF OPERATION

1 HARMONIC NUMBER AMPLIFIER

The Harmonic Number Amplifier A1U1 multiples the Sweep+Tune voltage from the RF Section by a factor of −0.4n, where "n" is the BAND number selected on the RF Section panel (Table 8-4). The Sweep+Tune voltage is proportional to the 1st LO YIG-tuned oscillator voltage in the 8555A RF Section. This voltage varies linearly from −5.000 Vdc ±5 mV with the 1st LO at 2.05 GHz, to −10.000 Vdc ±5 mV with the 1st LO at 4.1 GHz. Precision resistors in the Harmonic Number Amplifier circuit are switched by relays to set the gain of the circuit relative to the harmonic mixing number of the 8555A band that is selected.

2 N = + or − AMPLIFIER

A +9 Vdc reference voltage from the YIG Driver assembly A3 is applied to the input of the n = ± Amplifier. The function of this circuit is controlled by relays K7 and K8 to provide either a +9 Vdc output level for the plus mixing bands of the 8555A, or −9 Vdc for the minus mixing bands. Relays K7 and K8 are controlled by Band Code "bit" E from the RF Section.

3 IF = .550 GHz/2.05 GHz NETWORK

When bands are changed on the 8555A RF Section, either .550 GHz or 2.05 GHz is used as the 1st IF. The IF = .500 GHz/2.05 GHz offset network alters the input to the Summing Amplifier to compensate for the IF change. This is accomplished by Band Code "bit" D and relay K5. Precise level corrections for an IF of 2.05 GHz are made by adjusting R37, ADJ 4. Adjustment of R36, ADJ 5, corrects for improper input level to the Summing Amplifier for an IF of .550 GHz.

4 SUMMING AMPLIFIER

Summing Amplifier A1U2 combines the output from the Harmonic Number Amplifier with the output from the IF = .550 GHz/2.05 GHz Network to produce a voltage proportional to the band and frequency to which the analyzer RF Section is tuned. The output from the Summing Amplifier is applied to the YIG Driver Assembly A3 (Service Sheet 4).

5 LOGIC DECODERS/RELAY DRIVERS

Transistors A1Q1 through Q8 and their associated relays operate as logic decoders of Band Code "bits" from the 8555A. Band Code signals of either +20 or −12 Vdc from the analyzer RF Section are utilized to control the switching of precision resistors in the circuits of the Harmonic Number Amplifier, to control the output polarity of the n = ± Amplifier, and to offset the input to the Summing Amplifier by the IF = .550 GHz/2.05 GHz Network.

TROUBLESHOOTING PROCEDURE

1 HARMONIC NUMBER AMPLIFIER

Set switch A1S1 to TEST position and check at A1TP2 for a level of 0 Vdc ±1 mV. Set switch A1S1 back to OPR position. (If test voltages are out of tolerance see Paragraph 5-9 for adjustment procedure.) Connect voltmeter to A1TP1. Select spectrum analyzer BAND = 1 − /IF = .550 GHz, and SCAN WIDTH to ZERO. Adjust analyzer FREQUENCY control for an indicated voltage level of −5.000 Vdc ±1 mV at A1TP1. Connect the voltmeter to A1TP2 and check for a level of +2.000 Vdc ±2 mV. Select analyzer bands n = 2± and check for a level of +4.000 Vdc ±3 mV, then bands n = 3± for +6.000 Vdc ±4 mV, and finally bands n = 4± for +8.000 Vdc ±5 mV. Amplifier A1U1 has a gain of −0.4n with "n" controlled by Logic Decoder/Relay Drivers (see Table 8-4). If improper Harmonic Number Amplifier action is indicated, see Paragraph 8-30 for Operational Amplifier Troubleshooting Procedure.

2 n = + or − AMPLIFIER

Set YIG Driver Assembly switch A3S1 to TEST position and check voltage at A1TP5 for a level of 0 Vdc ±1 mV. (If test voltages are out of tolerance see Paragraph 5-9 for adjustment procedure.) Set switch A3S1 to OPR position and select BAND n = 1 − /IF = .550 GHz on analyzer RF section. Check voltage level at A1TP5 for −9.0 Vdc ±0.3 V. Switch analyzer to BAND n = 1 + /IF = .550 GHz and check for a +9.0 Vdc ±0.3 V level at A1TP5. Switch analyzer from BAND n = 1 − through n = 4+. A1TP5 voltage readings should be ±9.0 Vdc ±0.3V on all bands, showing positive polarity on n = + bands and negative polarity on n = ± bands. Amplifier A1U5 has a gain of 1 at all times, with output polarity controlled by Band Code "bit" E, which alternately switches relays K7 and K8 as bands are progresively selected (see Table 4 below). If improper n = ± Amplifier action is indicated see Paragraph 8-30 for Operational Amplifier Troubleshooting Procedure.

Table 8-4. Relay Operations by Band Code Bits

Analyzer Harmonic Number	Band Code "Bits" A	B	D	E	Relay A1K1	Relay A1K2	Relay A1K5	Relay A1K7	Relay A1K8
n = 1−*	0	0	1	0	closed	closed	open	open	closed
n = 1+*	0	0	1	1	closed	closed	open	closed	open
n = 1−	0	0	0	0	closed	closed	closed	open	closed
n = 1+	0	0	0	1	closed	closed	closed	closed	open
n = 2−	1	0	0	0	closed	open	closed	open	closed
n = 2+	1	0	0	1	closed	open	closed	closed	open
n = 3−	0	1	0	0	open	closed	closed	open	closed
n = 3+	0	1	0	1	open	closed	closed	closed	open
n = 4−	1	1	0	0	open	open	closed	open	closed
n = 4+	1	1	0	1	open	open	closed	closed	open

Band Code "Bits" 1 = +20 Vdc 0 = −12 Vdc

3 , 4 IF = .550 GHz/2.05 GHz NETWORK, SUMMING AMPLIFIER

Set switches A1S1 and A3S1 to TEST position and check A1TP7 for a level of 0 Vdc ±1 mV. (If test voltages are out of tolerance see Paragraph 5-9 for adjustment procedure.) Return switches A1S1 and A3S1 to OPR. Set analyzer to BAND n = 1 − /IF = .550 GHz, SCAN WIDTH to ZERO, and adjust FREQUENCY dial for a voltage level of −5.000Vdc at A1TP1. Measure voltage at A1TP7 for an indicated level of −1.463 Vdc ±2 mV. Select BAND n = 1 + /IF = .550 GHz, and check at A1TP7 for a voltage level of −2.536 Vdc ±2 mV. Shift to BAND n = 2 − and check at A1TP7 for a voltage level of −2.000 Vdc ±2 mV. Check BAND n = 2 + for −6.000 Vdc ±3 mV at A1TP7. The 550 MHz and 2.05 GHz IF offset is controlled by Band Code "bit" D (see Table 8-4 above). If improper Summing Amplifier action is indicated, see Paragraph 8-30 for Operational Amplifier Troubleshooting Procedure.

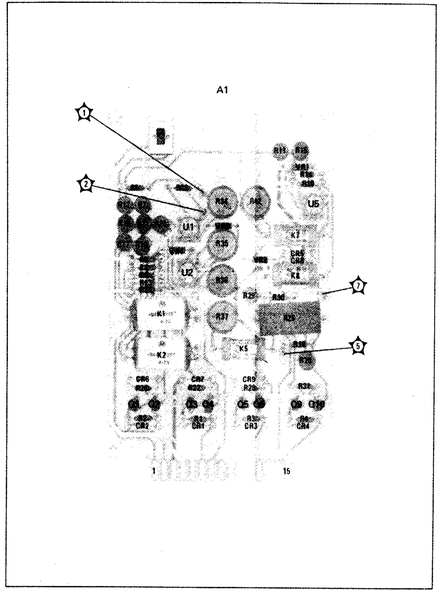
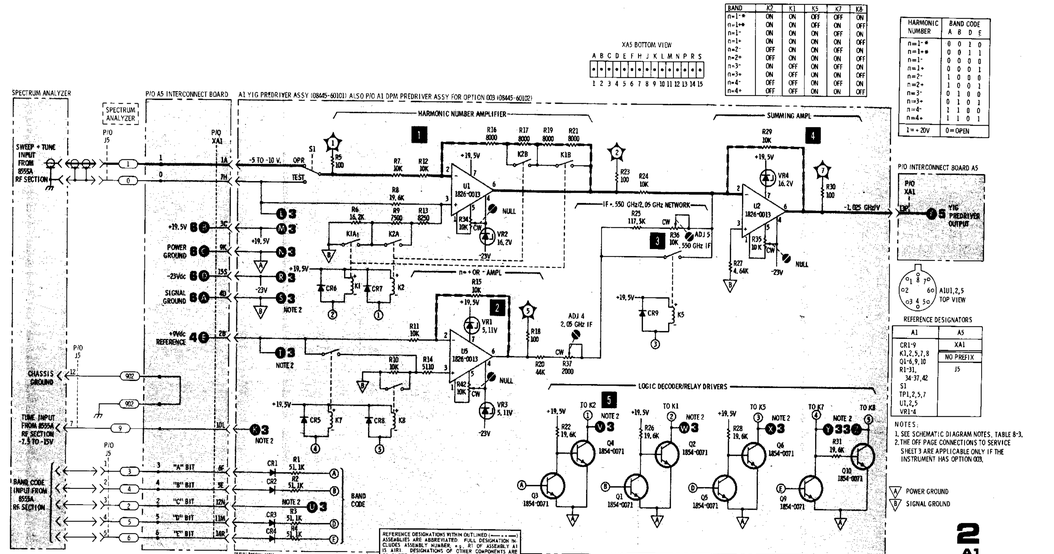


Figure 8-9. A1 Predriver Assembly of 8445B (Except Option 003)



BAND	K7	K6	K5	K4	K3
n-1*	ON	ON	OFF	OFF	ON
n-1+	ON	ON	OFF	ON	OFF
n-1	ON	ON	ON	OFF	ON
n-1-	ON	ON	ON	ON	OFF
n-1*	OFF	ON	ON	OFF	ON
n+2	OFF	ON	ON	ON	OFF
n+3	ON	OFF	ON	OFF	ON
n+3-	ON	OFF	ON	ON	OFF
n+4	OFF	OFF	ON	OFF	ON
n+4-	OFF	OFF	ON	ON	OFF

HARMONIC NUMBER	BAND CODE A	B	D	E
n-1*	0	0	1	0
n-1+	0	0	1	1
n-1	0	0	0	0
n-1-	0	0	0	1
n+2-	1	0	0	0
n+2+	1	0	0	1
n+3	0	1	0	0
n+3-	0	1	0	1
n+4-	1	1	0	0
n+4-	1	1	0	1

1= +20V 0= OPEN

A1	A5
CR1-9 K3,2,5,7,8 Q1-6,9,10 R1-31, 34-37,42 S1 TP1,2,5,7 U1,2,5 VR1-4	XA1
	NO PREFIX
	J5

Figure 8-10. YIG Predriver Schematic Diagram

SERVICE SHEET 3

DPM PREDRIVER (OPTION 003 ONLY)

The additional circuits of the Digital Panel Meter Predriver part of the Option 003 Assembly A1 shown on Service Sheet 3, are similar to the circuits on the Standard Model Assembly A1 shown on Service Sheet 2. The longer Option 003 Predriver Assembly A1 board consists of the DPM/Predriver circuits mounted adjacent to the mother board A5, with the YIG Predriver circuits behind the front panel and directly below the A7 DPM Assembly.

PRINCIPLES OF OPERATION

1 Except for the input voltage level to the A1 Option 003 Assembly, the Harmonic Number Amplifier, the n = ± Amplifier, the IF = .550 GHz/2.05 GHz Network, and the Summing Amplifier of the D²M Predriver operate the same as the YIG Predriver circuits of Service Sheet 2. The −7.5 to −15 voltages for the DPM Predriver originate in the Tune Buffer Amplifier of the 8555A.

2 The Band Code Logic "C" feeds a 0 or −12 V "bit" to Q7 on all bands involving frequencies of 0 to 18 GHz, allowing Q8 to energize K11. With K11 contacts closed, the 0 to −18.00 Vdc output (for 0 — 18.45 GHz) from the DPM Pre-driver is fed to the DPM, giving a voltage display of the frequency which the 8555A RF Section is receiving.

TROUBLESHOOTING PROCEDURE

The 8445B Preselector may operate properly with either no DPM frequency display, or with an incorrect display. To correct for a malfunction in the DPM circuitry use the following procedure.

1 With the 8555A RF Section operating and coupled to the 8445B, set the 8555A to BAND n = 1− /IF = .550 GHz and tune FREQUENCY to zero GHz. Check for −7.5 V from A1TP3 to ground (A3TP2). With FREQUENCY tuned to 2 GHz check for −15 volts at A1TP3. Lack of these voltages indicates a malfunction in the 8555A RF Section, or in the cabling between the 8555A and the 8445B. If these voltages are obtained, repeat the zero GHz check. Indication should be zero volts reading at A1TP8. Then set to BAND n = 4+ with FREQUENCY tuned to 18.450 GHz for a reading of 18.000 volts. If these voltages are not obtained the malfunction is in the DPM Predriver. (Refer to Troubleshooting Procedure for Service Sheet 2, or Predriver Adjustment, Paragraph 5-9.) If voltages are correct, incorrect frequency displays indicate malfunction in the digital panel meter itself. (Refer to Operating and Service Manual for the Model 34740A Measurement System, part of the Option 003 Manual Supplement.)

2 If display voltage is present at A1TP8 but not at input to the DPM, or if relay K11 does not close or open, check for Band Code "C" voltages when switching between BAND n = 4+ and BAND n = 6. Check for an open or shorted Q7, Q8, or K11 relay coil.

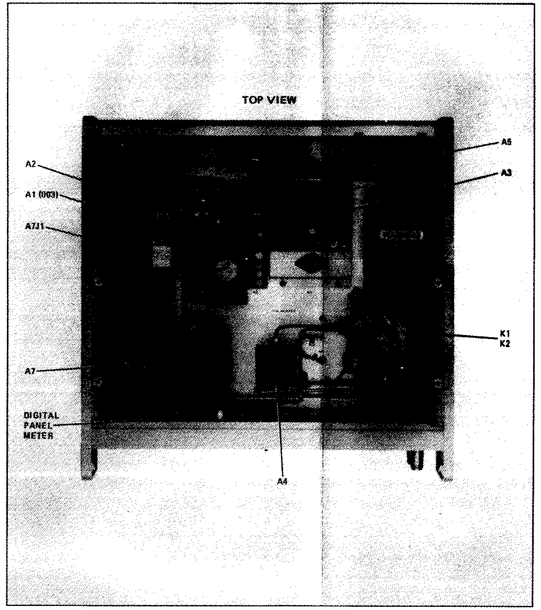


Figure 8-11. Top View of 8445B With Option 003 Including Digital Display A7.

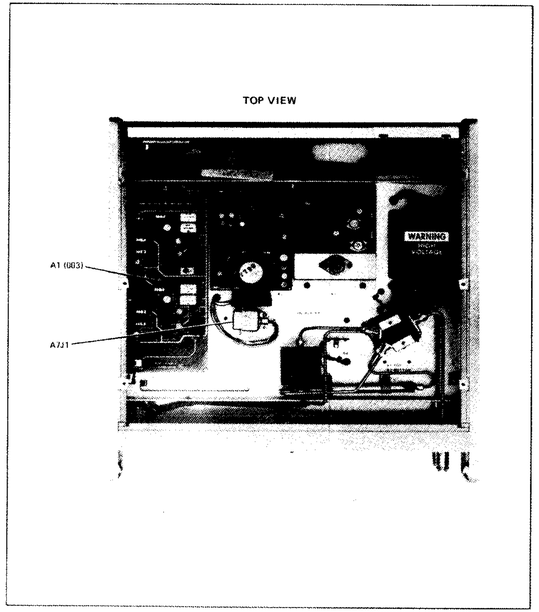


Figure 8-12. Top View of 8445B, Option 003 With A7 Removed.

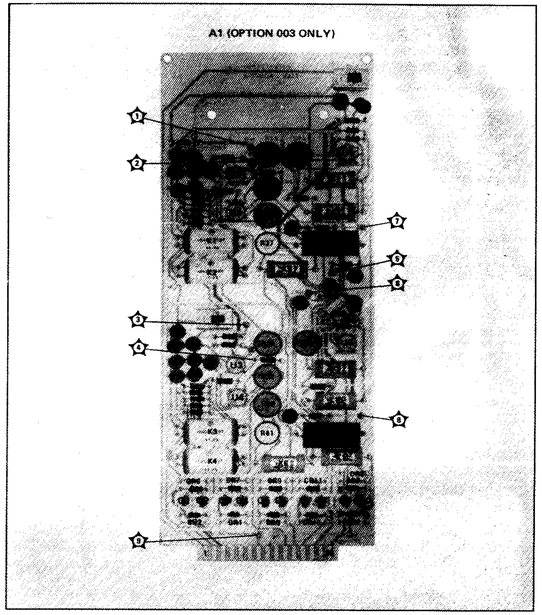


Figure 8-13. A1 Predriver Assembly of 8445B (Option 003)

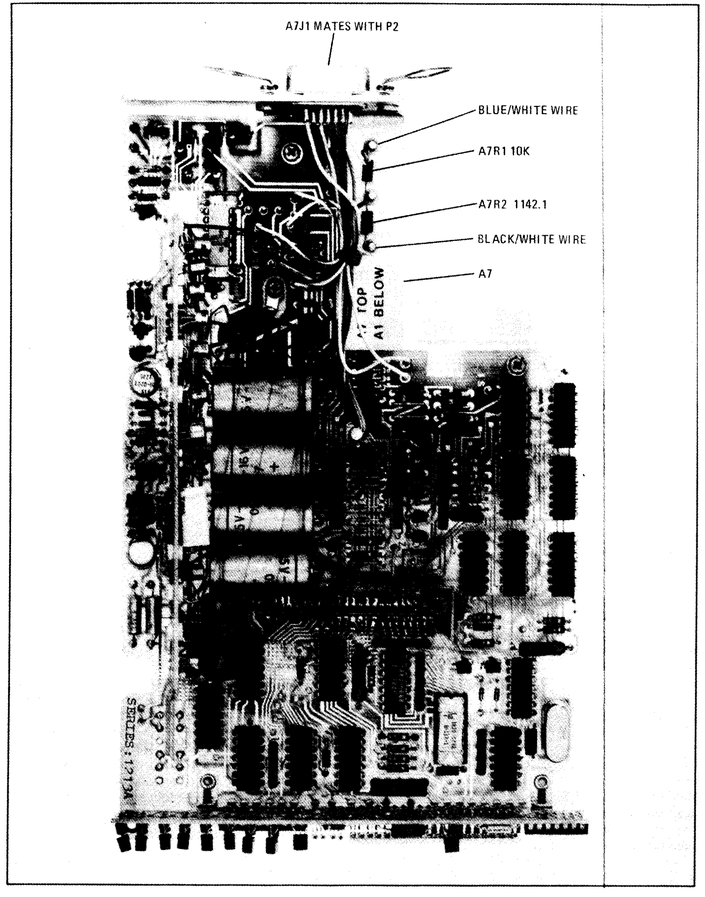
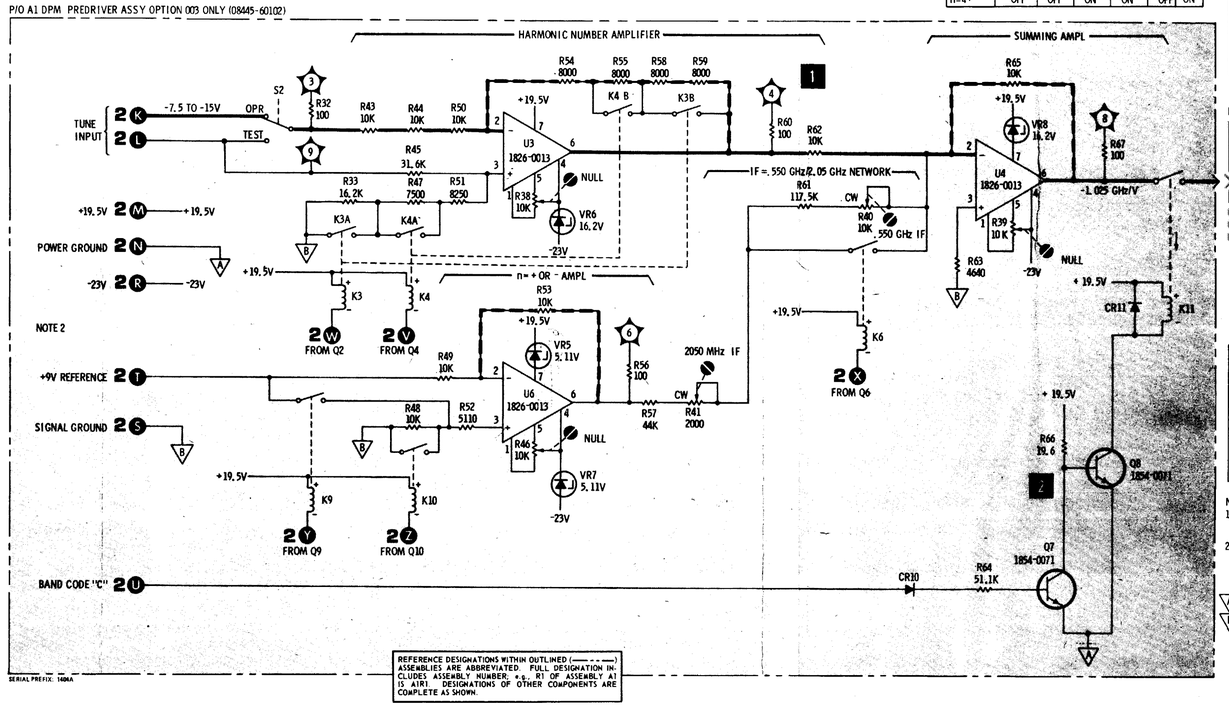


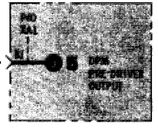
Figure 8-14. A7 Display Board (See Option 003 Supplement For Details) A7 8445B.

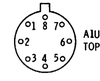
BAND	K4	K3	K6	K9	K10	K11
n=1-*	ON	ON	OFF	OFF	ON	ON
n=1+*	ON	ON	OFF	ON	OFF	ON
n=1-	ON	ON	ON	OFF	ON	ON
n=1+	ON	ON	ON	ON	OFF	ON
n=2-	OFF	ON	ON	OFF	ON	ON
n=2+	OFF	ON	ON	ON	OFF	ON
n=3-	ON	OFF	ON	OFF	ON	ON
n=3+	ON	OFF	ON	ON	OFF	ON
n=4-	OFF	OFF	ON	OFF	ON	ON
n=4+	OFF	OFF	ON	ON	OFF	ON

HARMONIC NUMBER	BAND CODE C
n 1 - *	0
n 1 +*	0
n 1 -	0
n 1 +	0
n 2 -	0
n 2 +	0
n 3 -	0
n 3 +	0
n 4 -	0
n 4 +	0
1-20V	0 = OPEN



P/O INTERCONNECT BOARD A5





REFERENCE DESIGNATIONS

A1	A5
CR10-11 K3,4,6,9-11 Q7,8 R32,33,38-41, 43-67 S2 TP3,4,6,8,9 U3,4,6 VR5-8	XA1

NOTES:
1. SEE SCHEMATIC DIAGRAM NOTES, TABLE 8-3.
2. SEE SERVICE SHEET 2 FOR MATING DETAILS TO INTERCONNECT BOARD.

A POWER GROUND
B SIGNAL GROUND

3
A1

Figure 8-15. DPM Predriver Schematic Diagram

SERVICE SHEET 4

Service Sheet 4 contains the schematic diagram of Assembly A3 YIG Driver circuits and controls required to feed the necessary current values to the YIG filter to tune it from 1.8 to 18 GHz. On this assembly are the +9 volt IF Offset Supply (used on the Predriver n = ± Amplifiers), the YIG driver circuits consisting of a Summing Amplifier and a Driver amplifier, a regulated + 28 volt supply for YIGs requiring internal heaters, and the Automatic Switching Control circuit, shown on Service Sheet 5.

PRINCIPLES OF OPERATION

❑ +9 VCLT IF OFFSET SUPPLY

Resistor A3R2 and the 9 volt breakdown diode VR1 form a simple regulated +9 volt power supply. The + 9 volt source is utilized by the n = ±Amplifier A1U2 to provide an IF frequency offset. Switch S1 is provided for test and adjustment purposes.

❑ YIG DRIVER

The YIG Driver circuit includes a Summing Amplifier and a YIG Current Driver Amplifier. The voltage to the Summing Amplifier from the YIG Predriver is a negative voltage of 1.025 GHz/V. This linear voltage/frequency input, in conjunction with FREQ OFFSET controls TRACKING controls, and two breakpoint controls, process the YIG magnet current to produce an overall linear voltage/frequency response of the YIG filter. The YIG frequency/coil current relationship is approximately 25.7 mA/GHz, The YIG magnet current flows through R12 and R13, Q4, and the magnet coil. Negative tuning voltages from the predriver are inverted to positive by U1 and control the conduction of Q4. The YIG current Q4 allows to flow is partially controlled by the gain of U1. This is basically the ratio of R11 to R9, or approximately 9:1. The panel FREQ OFFSET control feeds a small positive bias to the inverting input of U1, and is used as a manual control for compensation of the YIG current. It is used to set the YIG on frequency at 2 GHz when checking tracking. The internal COARSE TRACKING and the panel TRACKING controls help to determine the gain of U1 and also the slope of the YIG magnet current. With TRACKING at zero, the COARSE TRACKING is adjusted to tune the YIG on frequency at 14 GHz (outlined in Paragraph 5-10). In normal operation the FREQ OFFSET is used to tune the YIG at 2 GHz, and the panel TRACKING control is adjusted to tune the YIG to frequency at 8 GHz. Any further trimming that maybe necessary is accomplished with the panel FREQ OFFSET control.

Linearity Correction. The current of the YIG magnet is essentially linear from 1.8 GHz at ±70mA, to 18 GHz at ±700 mA (25.7 mA/GHz). However, above approximately 14 GHz the magnet core starts to saturate. To correct-for this, as the input voltage approaches the 14.7 V zener voltage of VR2, the zener conducts, shunting R3 and R8 across the U1 input impedances R21 and R9, increasing the gain of U1 and therefore the YIG current. Another similar breakpoint is developed when the input voltage approaches the zener voltage of VR3. The result is a linear input voltage/frequency response for the YIG filter. The 16 and 18 GHz ADJ resistors R24 and R29 are vernier adjustments on the VR breakdown voltage points.

❑ +28 VOLT YIG HEATER SUPPLY

When a YIG requiring an internal heater is used, the +28 V power supply produces the required heater current. The unregualted +40 volt source is regulated to approximately 0.7 volts less than the VR6 breakdown diode voltage. The circuit is included on all A3 assembly boards, even if the YIG supplied requires no heater.

TROUBLESHOOTING PROCEDURE

YIG DRIVER ASSEMBLY A3

When a malfunction has been isolated to the YIG Driver Assembly, perform the following procedure. Connect Preselector to Analyzer, apply power, and allow at least 30 minutes for equipment to stabilize. Make all voltage measurements in reference to A3TP2 (common ground test point).

EQUIPMENT REQUIRED:

8555 A	HP 8555A/8552/140
Digital Voltmeter	HP 3480B/3484A

❑ +9 VOLT IF OFFSET SUPPLY

If +9 volts is not being supplied to Predriver A1U2: Set switch to TEST position and check for a voltage level of +9 volts ±0.3 V at Assembly A3 test point K (junction of R2 and VR1). If voltage is incorrect, check R2 and VR1. If voltage is +9 volts check switch A3S1 and circuit wiring between +9 volt source and Predriver A1U2.

❑ YIG DRIVER

Set Analyzer controls as follows:

BAND	n=l—/IF=.550 GHz
FREQUENCY.	.l.5GHz
SCAN WIDTH	ZERO
SCAN TIME	10 MILLISECONDS
SCAN MODE	..INT
SCAN TRIGGER.	LINE

If Preselector is inoperative and driver section is suspected, check fuse A3F1. If open, first check fuse F2 on Power Supply Assembly A2. (If A2F2 is open there is no —23 volts bias on A3U1, turning on the YIG Driver transistors excessively, resulting in burn out of A3F1.) If A2F2 is not open, try another A3F1. If the fuse burns out again, check transistors Q2, Q3, and Q4, and operational amplifier troubleshooting. If fuse A3 F1 is good, with a digital voltmeter test for approximately +37 volts at A3TPF. This voltage is unregulated and will vary according to line voltage input and YIG frequency. Set analyzer to BAND n = 4+ and tune FREQUENCY control to 18 GHz. The voltage level at test point F is unregulated but should be approximately +30 volts. If there is no change in voltage level between 1.5 and 18 GHz settings, check the input levels at pins 2 and 3 of U1. The voltage difference between these pins and ground should not exceed 25 mV. The driver stage, consisting of U1, Q2, Q3, Q4, and associated components, function as a single operational amplifier. The normally less than 10 mV difference at the input of U1 is affected by adjusting COARSE FREQ OFFSET resistor R7. Amplifier U1 can be isolated from the driver transistors by first removing fuse F1 and then connecting a jumper from test point G to TP3. Repeat voltage measurements at input of U1. If voltage level differs by more than 25 mV, try adjusting resistor R7. If R7 has little or no effect, replace U1. If U1 appears to be good, check for open or shorted transistor(s) or diode(s) in the driver amplifier. (A shorted transistor or diode will normally cause fuse F1 to open.)

Linearity Correction Breakpoints. Connect the digital voltmeter to A3TP1. Select BAND n = 4+ with SCAN WIDTH at ZERO. Tune FREQUENCY control from 14 to 15 GHz, noting voltage level on digital voltmeter. Between 14 and 15 GHz the voltage should begin to increase, indicating breakdown of the diode. With the digital voltmeter at A3TPH, the breakdown should occur between 16 and 17 GHz. The procedure for making breakpoint tracking adjustments is outlined in Paragraph 5-10.

❑ +28 VOLT HEATER SUPPLY

When operating with the YIG heater connected, the voltage drop across R19 is approximately 1 volt. With the heater circuit open, the voltage drop should be less than 0.1 volt. When operating normally the voltage across R20 is approximately 1 volt less than that across VR6, and the voltage across R18 is 0.6 volt. Variations of any of these voltages should indicate which component is faulty.

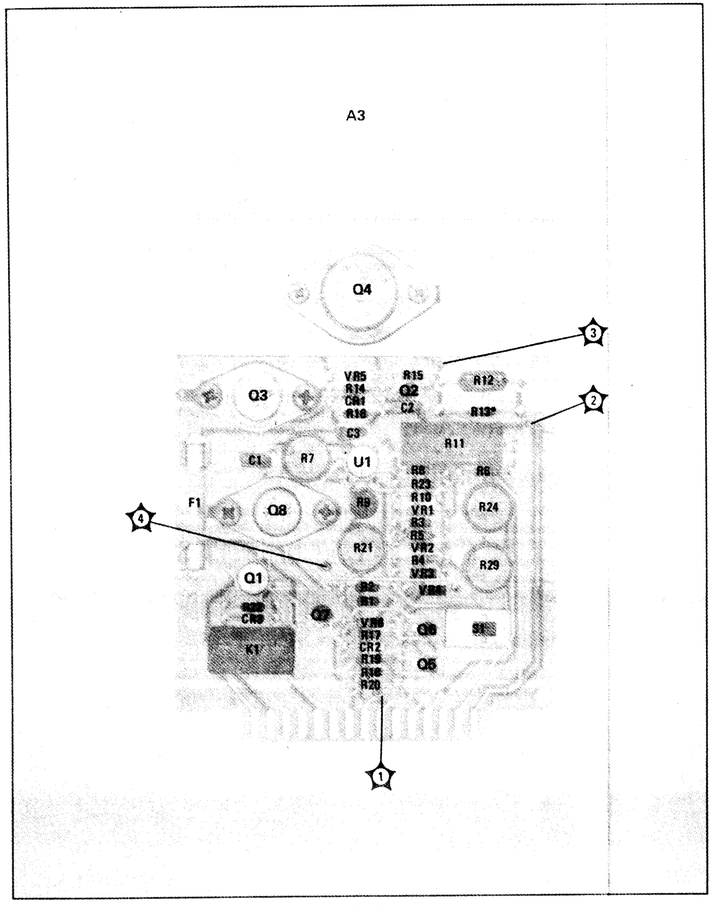


Figure 8-16. A3 YIG Driver Assembly

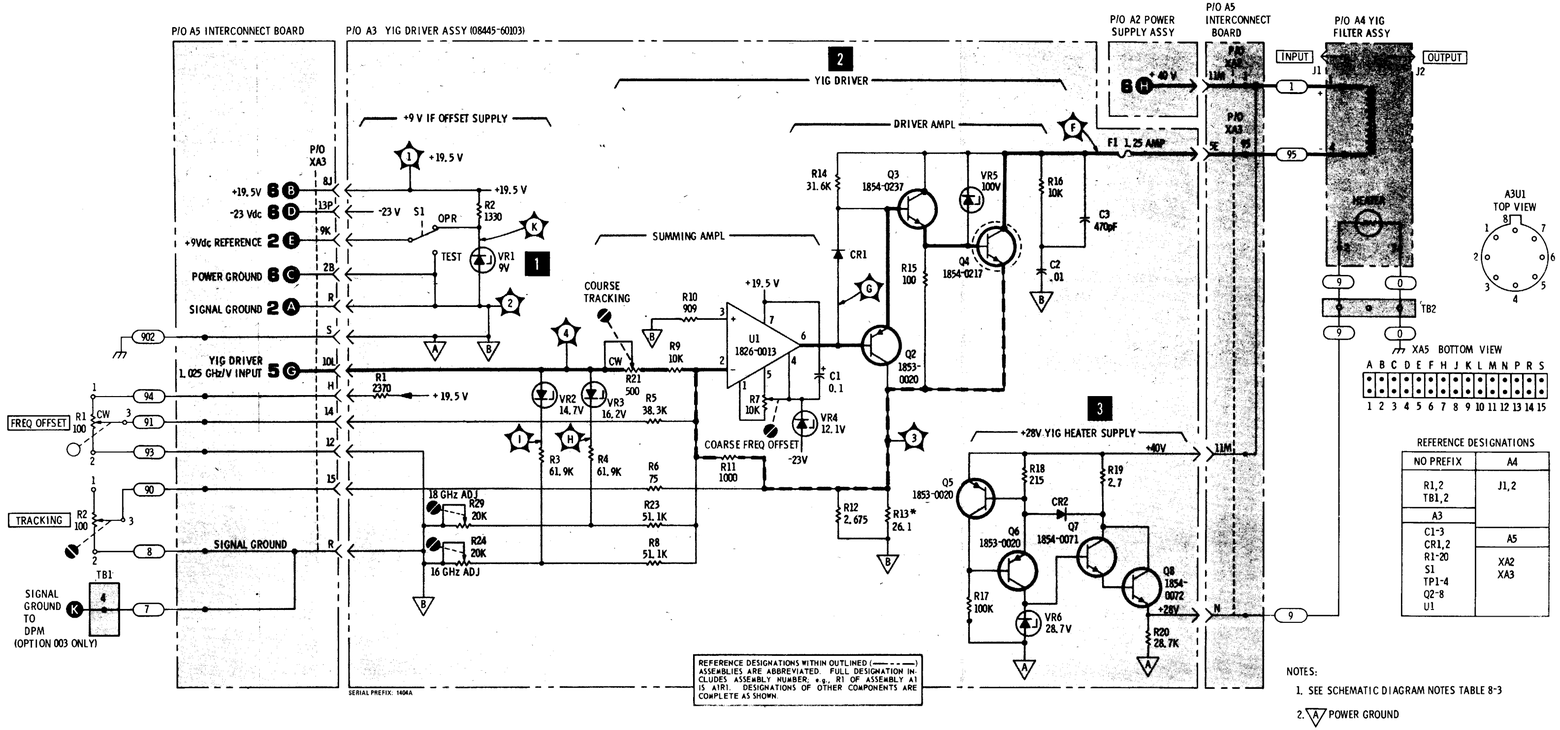


Figure 8-17. P/O YIG Driver Schematic Diagram

SERVICE SHEET 5

CONTROL AND SWITCHING CIRCUITS

General

Service Sheet 5 contains the schematic diagram for the input-output Coaxial Switch Driver circuitry, the Manual Control Buffer Amplifier, the Remote Control Buffer Amplifier, and the Automatic Switching Control circuitry. It also includes the panel controls of Standard, as well as Option 002 instruments.

1 COAXIAL SWITCH DRIVER

The Coaxial Switch Driver circuitry on Assembly A2 provides a polarized control voltage for the two input-output coaxial relays to connect either the YIG Filter or the Low-Pass Filter to the front panel ports. The coaxial relays are the polar latching type. When driven in one direction they latch until driven in the other direction. The driven direction depends cm the relative voltage levels across the coils. Depending on whether the base of A2Q2 is forward biased or not, the emitter of A2Q4 will either rise to nearly +40 volts, or drop to a low positive potential. Transistor A2Q8 acts as an inverter, lowering the positive potential of the emitter of A2Q5 when the emitter of A2Q4 rises. It raises the positive potential of the A2Q5 emitter when the A2Q4 emitter lowers. At any given time the top of the relay coils are either more positive than the bottom, or less positive, resulting in either upward or downward current flow in the coils. Reversal of current direction reverses the relay contacts. When test point E is highly positive the relays are in the YIG Filter position. If any of the four A, B, D, or E Band Code “bits” is positive ("1" or +20 V), the relays are driven to the YIG Filter position. If all four “bits” are negative (0 or – 12 V), or if there are no “bits”, A2Q2 is either reverse or zero biased and the relays reverse, connecting the Low-Pass Filter to the front panel ports.

2 MANUAL CONTROL BUFFER AMPLIFIER

The Manual Control Buffer Amplifier A2U2 is not operative in Standard Models, With Option 002, manual controls are added. (See Figure 8-4.) If the panel MODE switch S2 is in the MANUAL position, the base of A2Q6 is grounded through A2R16, forward biasing A2Q6 and driving the coaxial relays into the YIG Filter position. The COARSE and FINE controls feed the required – 1.025 GHz/V to the YIG Driver to tune the YIG Filter. The manual COARSE and FINE potentiometers together control dc bias voltages to amplifier A2U2 to produce the necessary – 1.025 GHz/V required to tune the YIG Filter manually. The COARSE tune control is calibrated in frequency from 0 to 20 GHz. The FINE tune control is calibrated from –500 to +500 MHz. The resistive networks composed of A2R7, A2R11, and A2R12 provide a voltage offset that is equal to 500 MHz. With the FINE control centered (0 MHz), the resulting voltage offset corrects the input voltage so that the frequency calibration of the COARSE tune control reads correctly. Operational amplifier A2U2 is an inverting amplifier with unity gain.

3 REMOTE CONTROL BUFFER AMPLIFIER

Remote control of the YIG Filter tuning is possible when the Analyzer is either off, disconnected from the Preselector, or if the Preselector incorporates Option 002 and the front panel switch is set to REMOTE. The Remote Control Buffer Amplifier produces a voltage at its output equal to the voltage difference applied across the floating BNC remote input connector, divided by 1.025. A2U3 and its associated circuitry form a standard unity gain differential amplifier. The output of A2U3 is routed to the Automatic Switching Control (see 4 below) or through the MODE switch to the YIG Driver input.

4 AUTOMATIC SWITCHING CONTROL

Standard Models. The A3Q1/Kl Automatic Switching Control relay connects the YIG Driver input to either the YIG Predriver output or to the Remote Control output. For the Standard 8445B, relay driver A3Q1 is provided -t 20 volts from the 8555A RF Section through interconnect cable W3. The +20 volts turns on A3Q1 and energizes relay A3K1. With A3K1 energized the Predriver output is routed through contacts 5 and 3 and through the interconnect wiring to the YIG Driver input. If the +20 volts is removed from A3Q1 by either turning off the 8555A or disconnecting Auxiliary B interconnect cable W3, relay A3K1 de-energizes and the Remote Amplifier output is fed to the YIG Driver input through relay contacts 1 and 6.

Option 003. When a digital panel meter is added, A3K1 connects the DPM Predriver output to the DPM drive circuitry as long as A3K1 is energized. In Standard Models the jumper between TB1 terminals 5 and 7 feeds the DPM. In Option 002 models this jumper is removed to allow feed through the MODE switch to the DPM.

TROUBLESHOOTING PROCEDURE

When a malfunction has been isolated to the Coaxial Switch Driver, the Manual Control Buffer Amplifier, the Remote Control Buffer Amplifier, or the Automatic Switching Control circuit, perform the following test procedure. Connect the Preselector to the Analyzer, apply power, and allow instruments to stabilize (Warmup time required only for measurements associated with amplifiers A2U2 and A2U3.) Make all voltage measurements in reference to A3TP2 (common ground point).

EQUIPMENT REQUIRED:

8555A Spectrum Analyzer . . . . . HP 8555A/8552/140
Digital Voltmeter . . . .HP 3480A
Power Supply . . . .HP 6205B

1 COAXIAL SWITCH DRIVER

Set Analyzer controls as follows: BAND n=l -/IF = .550 GHz, FREQUENCY to 1.5 GHz, and SCAN WIDTH to ZERO. (On Preselectors with Option 002, set MODE switch to AUTO.) Connect voltmeter to test point "A". Shift BAND Lever on the 8555A RF Section to select BANDs n=1 –/IF= .550 GHz through n=4+. The voltage level should be approximately +19.5 volts on all bands except n=1 –/IF=2.05 GHz. On this band it should be approximately O volts. Check voltage levels at test points B, C, D, and E for BAND n=1 –/IF=2.05 GHz, and BAND n=1+/IF=550 MHz. Use A2Q2, A2Q3, and A2Q4 transistor cases for test points B, Canal D. Compare levels with the typical values shown below.

Test Point	Voltage Level	
	BAND n = 1 –/IF = 2.05 GHz	BAND n = 1 +/IF = .550 GHz
B	+40 V	0 V
C	±2.7 V	+39 V
D	+40 V	1.2 V
E	+3.5 V	40 V

2 MANUAL CONTROL BUFFER AMPLIFIER

(Applies to instruments with option 002 only.) Check operational amplifier A2U2 for unity dc gain and inversion of input voltage. (Compare input voltage at A2U2 pin 2 with output at A2TP6,) For operational amplifier troubleshooting see Paragraph 8-30.

3 REMOTE CONTROL BUFFER AMPLIFIER

Connect a +10.000 volt power supply to REMOTE input on rear panel of Preselector, with positive to center conductor and negative to shield. Check voltage output from A2U3 as – 9.77 volts (10 V divided by 1.025). If incorrect, remove +10 volt power supply and check resistors and capacitors to input of A2U3, For operational amplifier troubleshooting see Paragraph 8-30.

4 AUTOMATIC SWITCHING CONTROL

The Automatic Switching Control transistor A3Q1 is held in saturation by either a +20 or a +19.5 volt dc fed to it through A3R22. In option 002 instruments, A3Q 1 is held in saturation regardless of Mode Switch Position, and signals should be approximately 0,1 volt provided the Analyzer is on and the interconnect cable is attached to the Preselector. Otherwise, Q 1 is non-conducting and approximately 38 volts should appear across it.

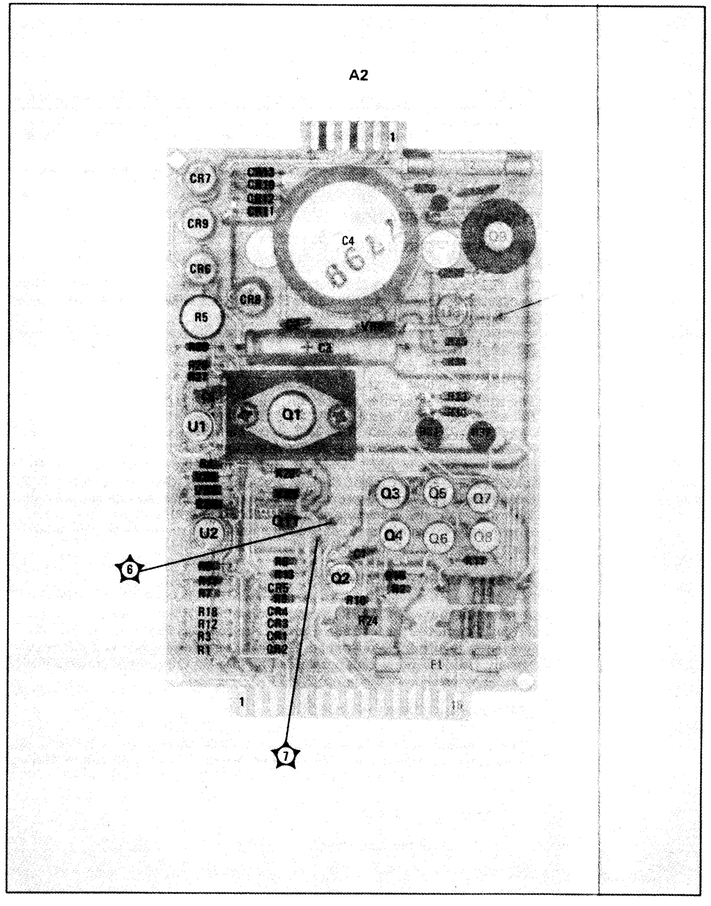


Figure 8-18. A2 Power Supply and Filter Switching Assembly

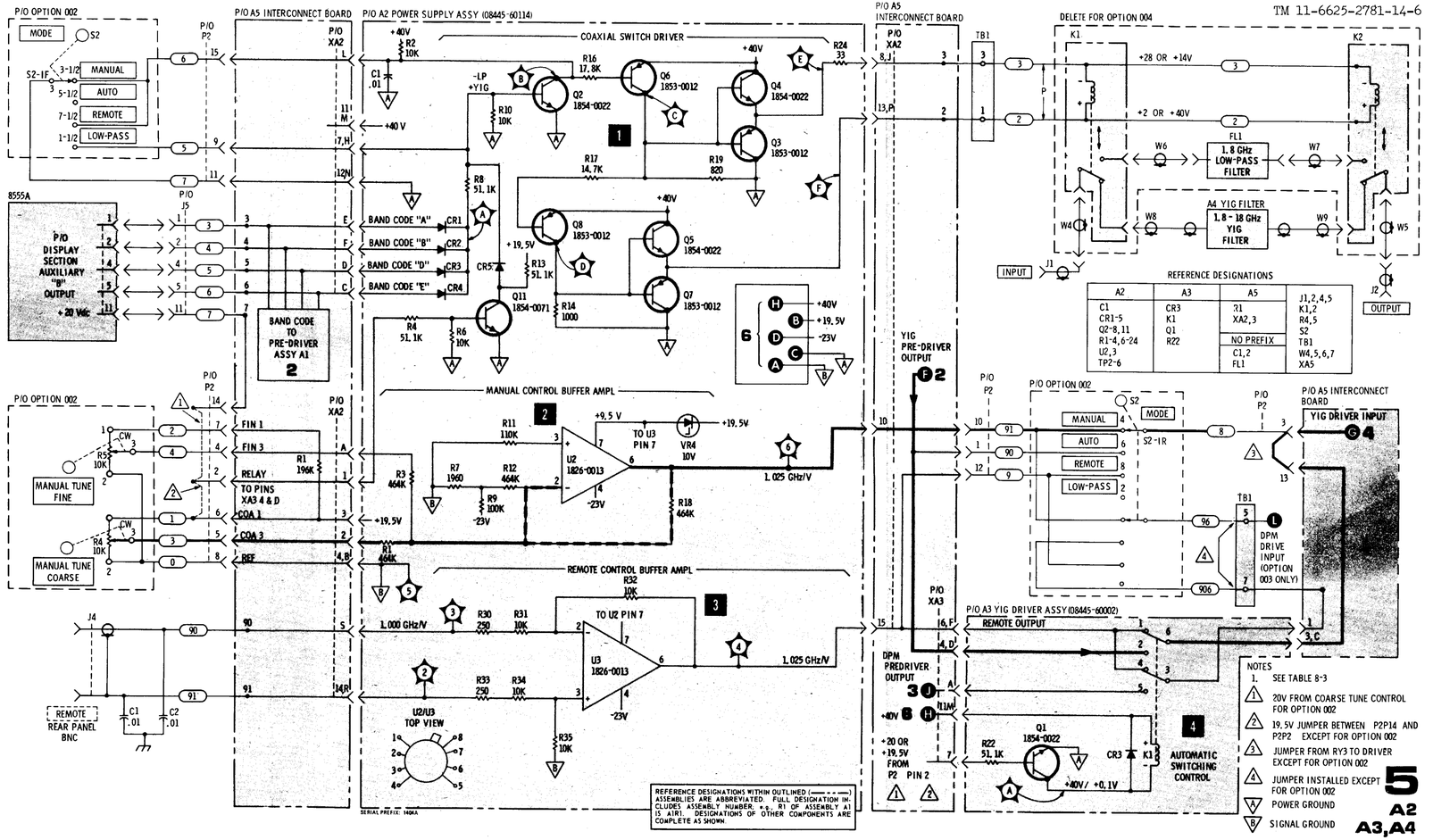


Figure 8-19. Remote and Manual Control Amplifiers/Switching Circuit Schematic Diagram

SERVICE SHEET 6

POWER SUPPLIES

General

Service Sheet 6 contains the schematic diagram for the unregulated +40 volt, and the regulated +19.5 and −23 volt power supplies. It also includes the wiring diagrams for the power transformer interconnections to the power line voltage module and selection card (see Figure 2-1). Power transformer T1 secondaries provide 27.7 Vrms at 1.5 A, and 27.7 Vrms at 0.1 A for associated power supplies.

THEORY OF OPERATION

1 +40 VDC POWER SUPPLY

The 27.7 Vrms secondary of power transformer T1 rated at 1.5 A is rectified by diodes A2CR6 through A2CR9 and is filtered by C4 to provide a +40 Vdc unregulated source.

2 +19.5 VDC POWER SUPPLY

The +40 Vdc source is electronically regulated to provide a +19.5 Vdc source. The monolithic integrated circuit A2U1 is a voltage regulator used to control the series regulator transistor A2Q1. Instantaneous current limiting is provided by A2R29 connected in series with the emitter of A2Q1. If output current is excessive, the voltage drop across A2R29 biases off the base circuit of a control transistor in A2U1, which in turn reduces the conductance of A2Q1, limiting the overload current. Such an overload should also burn out fuse A2F1. Over-voltage protection is provided by breakdown diodes A2VR8 and A2VR9. The voltage divider consisting of A2R5, A2R27, and A2R28, provides a reference voltage for the voltage controlling circuitry in the IC to provide adjustment of the +19.5 Vdc output.

3 −23 VOLT POWER SUPPLY

The 27.7 Vrms secondary of power transformer T1 rated at 0.1A is rectified by diodes A2CR10 through A2CR12 and is filtered by A2C3 to provide a −40 volt unregulated source. The −40 volt source is electronically regulated to −23 volts by a series regulator circuit using a 23.7 volt breakdown diode as a reference element. Overload protection is provided by fuse F2. Overvoltage protection is provided by breakdown diode A2VR6.

TROUBLESHOOTING PROCEDURE

When a malfunction has been isolated to one of the three power supplies, or to isolate a malfunction in one of the supplies, use the following procedure. Make all voltage measurements in reference to A3TP2 (common ground point).

EQUIPMENT REQUIRED:

Multi-function Meter . . . . . HP 427A

1 +40 VOLT SUPPLY

Disconnect interconnect cable W3. (Option 002, set to AUTO.) Remove line voltage to Preselector. Remove fuse A2F1 to isolate +40 V supply from +19.5 V supply. (If fuse open check 19.5 V supply.) Remove A1 and A3 boards. Resistance A1TPG to A2TP5 should read approximately 50K ohms. Remove A2 and check diodes A2CR6 through 9 and capacitor C4 for shorts or opens. Replace A2, apply power to Preselector and make quick check for unloaded voltage A2TPG to A2TP5 of approximately 55 volts, then turn off power. If voltage is low, check transformer secondary (grey and black wires) for 27.7 Vrms. Replace A2F1. Check A2 for short by replacing A2, reconnecting power and checking for approximately 34 volts from A2TPG to A2TP5. Repeat, adding A1 and checking for approximately 34 volts at A2TPG.

2 +19.5 VOLT SUPPLY

Check fuse A2F1. If not open, check for required approximate +38 volts from A2TPG to A2TP5. Remove line voltage and interconnect cable W3. Remove A2 assembly from Preselector. Check for a short on the +19.5 V line external to the power supply (XA2 pin 3 to ground). Typical resistance is 1200 ohms. Check A2VR8 and A2VR9 for shorts. Install A2 assembly, apply power and check for a voltage drop of 3.48 volts across diode A2VR7. Check for a voltage drop of approximately 0.2 volt across A2R29. Check for equal voltage levels (±3 mV) between ground and regulator module A2U1 pins 2 and 3.

3 − 23 VOLT SUPPLY

If fuse A2F2 is open, remove input line voltage from Preselector. Remove A1, A2, and A3 assemblies. Check A2TP5 to A2TP7 for short. If shorted, check A2VR6. Check for a short on the −23 volt line external to the power supply (XA2 pin 9 to ground). Typical resistance is 4,000 ohms. Remove A2 and check diodes A2CR10 through 13 and capacitor C3 for shorts or opens. Check diode A2VR5, transistors A2Q9 and 10, capacitor C5 and resistor R25. Install A2 assembly and apply power. Check input to rectifiers for 27.7 Vrms and −23.7 Vdc across VR5.

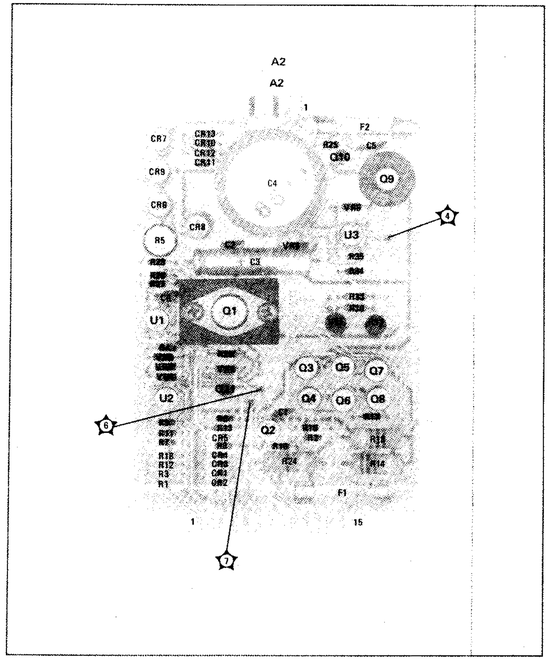


Figure 8-20. A2 Power Supply and Filter Switching Assembly

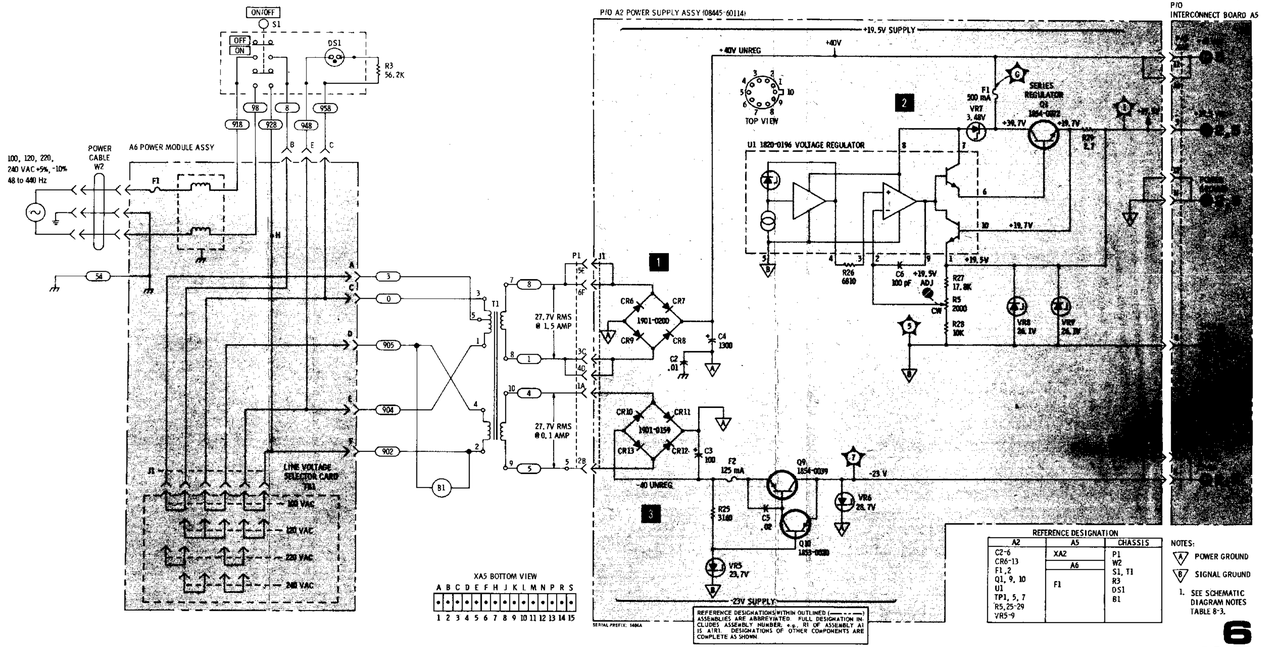


Figure 8-21. Power Supply and Power Line Module Schematic Diagram

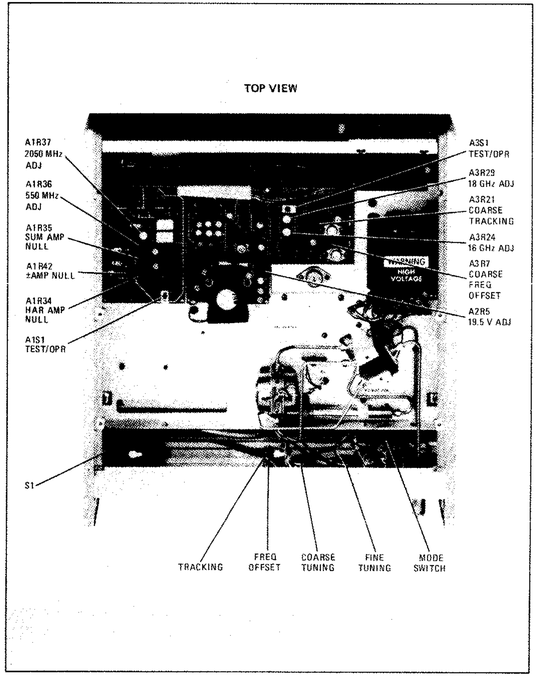


Figure 8-22. Adjustment Controls

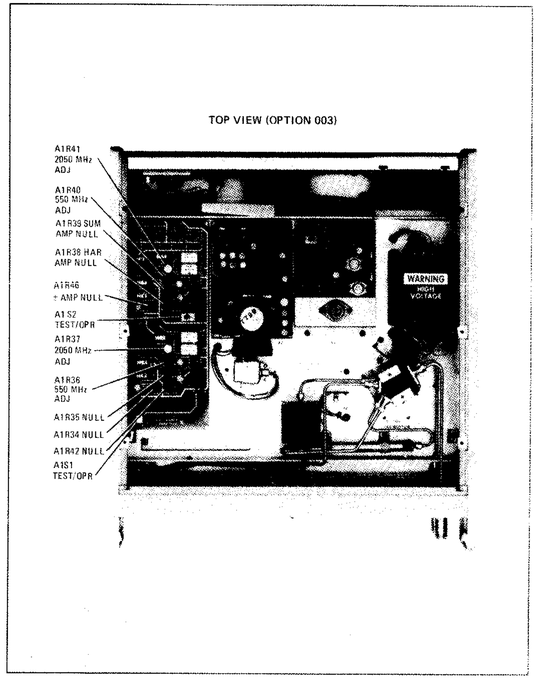
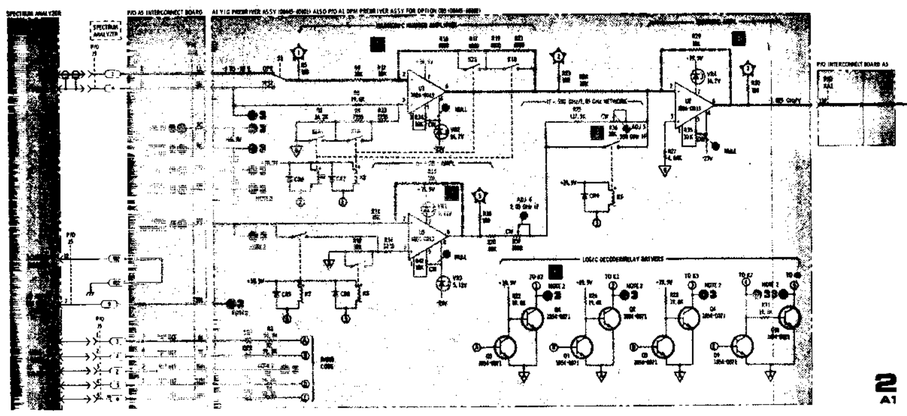


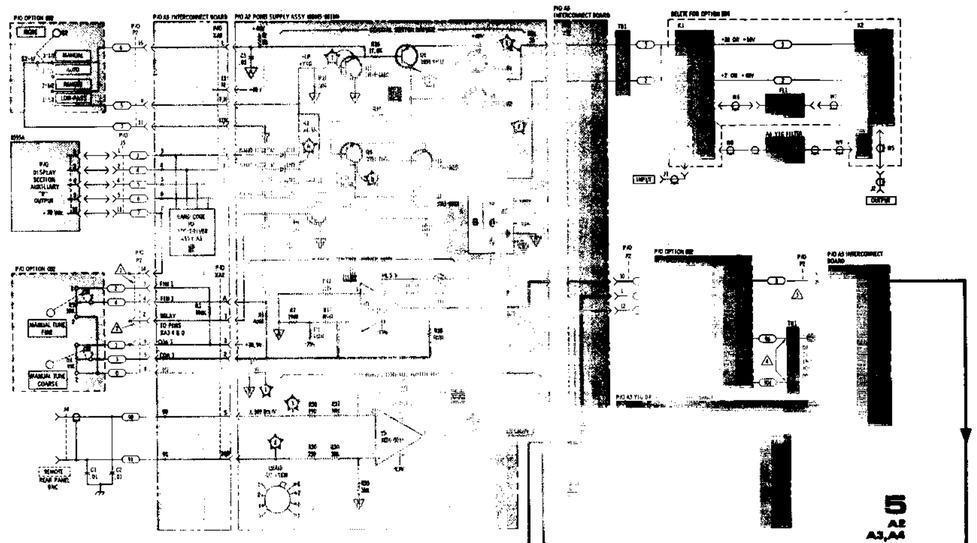
Figure 8-23. Option 003 A1 Adjustment Controls

A1 YIG PREDRIVER ASSEMBLY



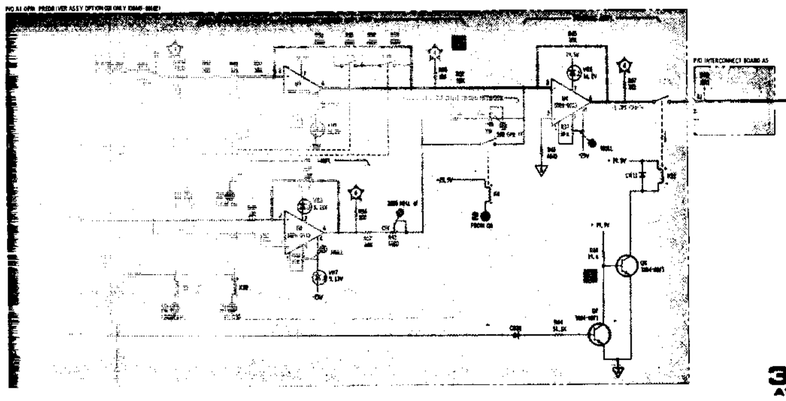
2
A1

P/O A2 POWER SUPPLY ASSEMBLY



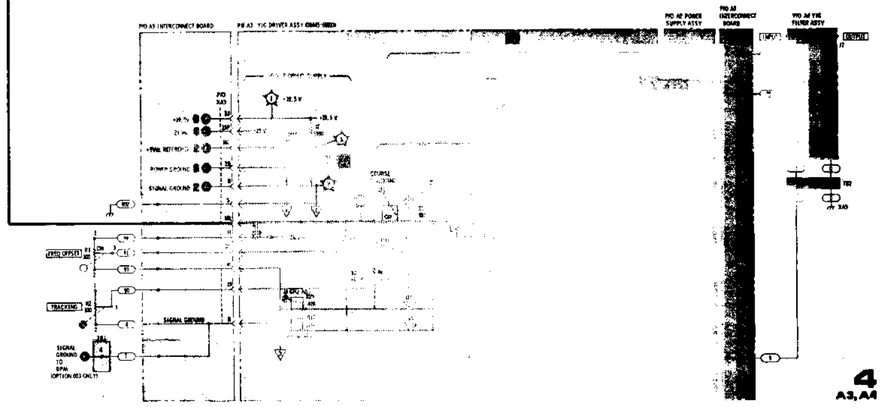
5
A2
A3,A4

P/O A1 DPM DRIVER ASSEMBLY OPTION 003 ONLY



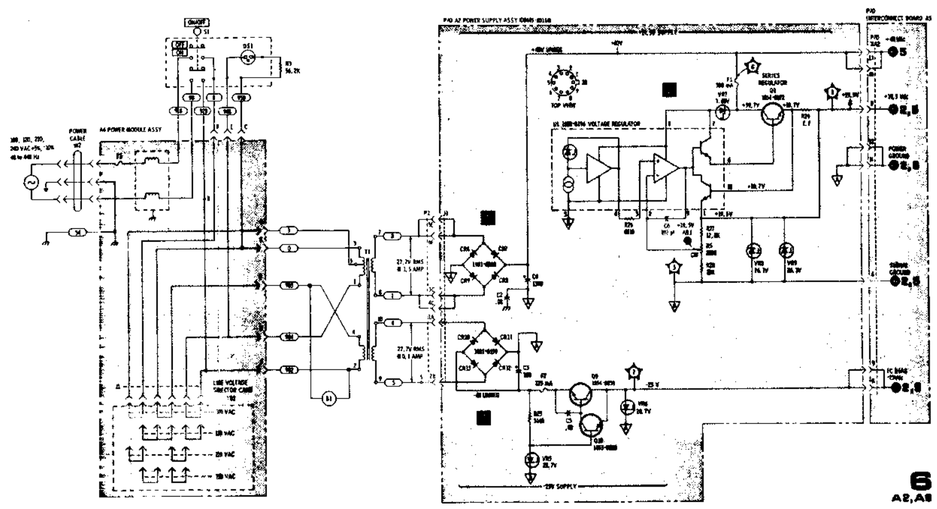
3
A1

A5 YIG DRIVER ASSEMBLY



4
A3,A4

P/O A2 POWER SUPPLY ASSEMBLY



6
A2,A8

HEWLETT-PACKARD MODEL 8445B
AUTOMATIC PRESELECTOR
SERIAL NUMBERS PREFIXED 1404A

OVERALL SCHEMATIC DIAGRAM
HP PART NUMBER 08445-90112

THIS DIAGRAM IS A SUPPLEMENT FOR THE MODEL 8445B OPERATING AND SERVICE MANUAL PRINTED JUNE 1975, HP PART NUMBER 08445-90109.

Figure 8-24. Overall Schematic Diagram.

APPENDIX B

SERVICE NOTE NO. 8555 A-1

HP MODEL 8555A SPECTRUM ANALYZER, RF SECTION
Serials Prefixed 1232A and Below

PRESELECTOR DPM MODIFICATION

HP 8555A RF Sections with serials listed above, require a circuit wiring modification before proper operation of the HP Model 8445B Option 003 Preselector can be achieved. The digital readout driver in the 8445B requires an input signal from the A4 YIG Driver Assembly in the 8555A.

This modification consists of adding a jumper wire on the plug-in A4 assembly plus adding a wire between A4 output connector and the rear panel P5 Auxiliary "B" connector.

PROCEDURE

1. Remove top and bottom covers from the 8555A.
2. Remove the A4, A5, and A6 board assemblies so that A4 can be modified and easy access to connector)5 can be obtained.
3. Connect an insulated 3 inch jumper wire between A4U7 pin 6 and pin 8 on the A4 board connector. Refer to Figure B-1.
4. Connect as insulated 4 inch wire between A10XA4 pin 8 (on interconnect board) and rear panel Preselector connector P5 pin 7. Refer to Figure B-2.
5. This completes the modification. Replace all board assemblies and top and bottom covers.

ELECTRICAL CHECK

1. With 8555A installed into Display Section, turn on power.
2. Center LO feed thru signal on CRT display.
3. With a dc voltmeter measure the voltage at AUXILIARY "B" on rear panel connector P5 pin 7. Voltage should be –7 .50 ±0.05V.
4. With frequency dial at 4100 MHz on the LO scale, voltage at P5-7 should be –15.00 ±0.05V.

Change your Operating and Service Manual per the partial schematic of the A4 assembly shown in Figure B-3.

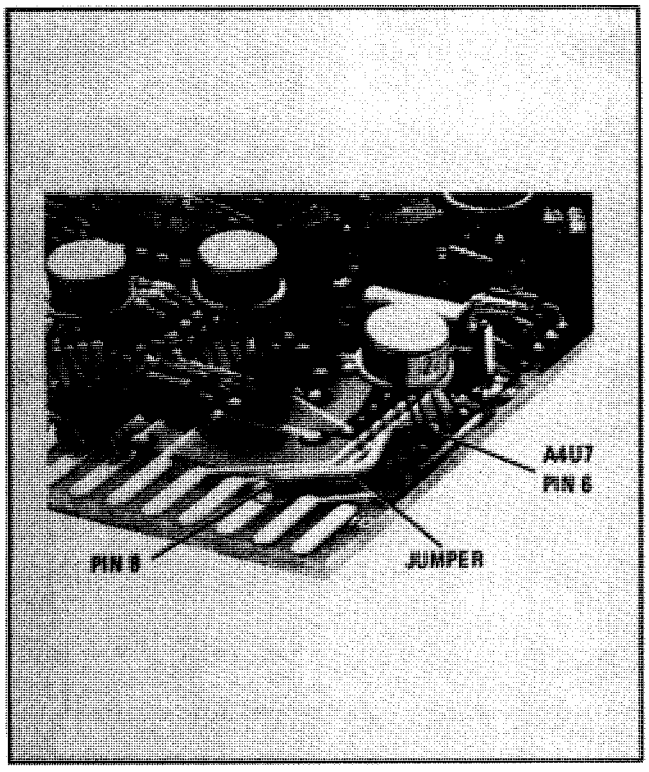


Figure B-1. Modified A4 Board

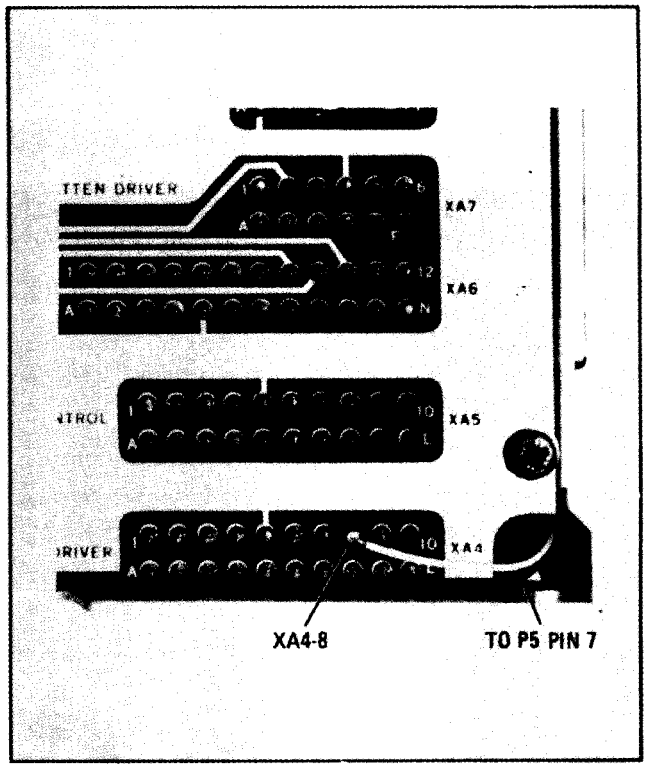


Figure B-2. Connection to A10XA4-8

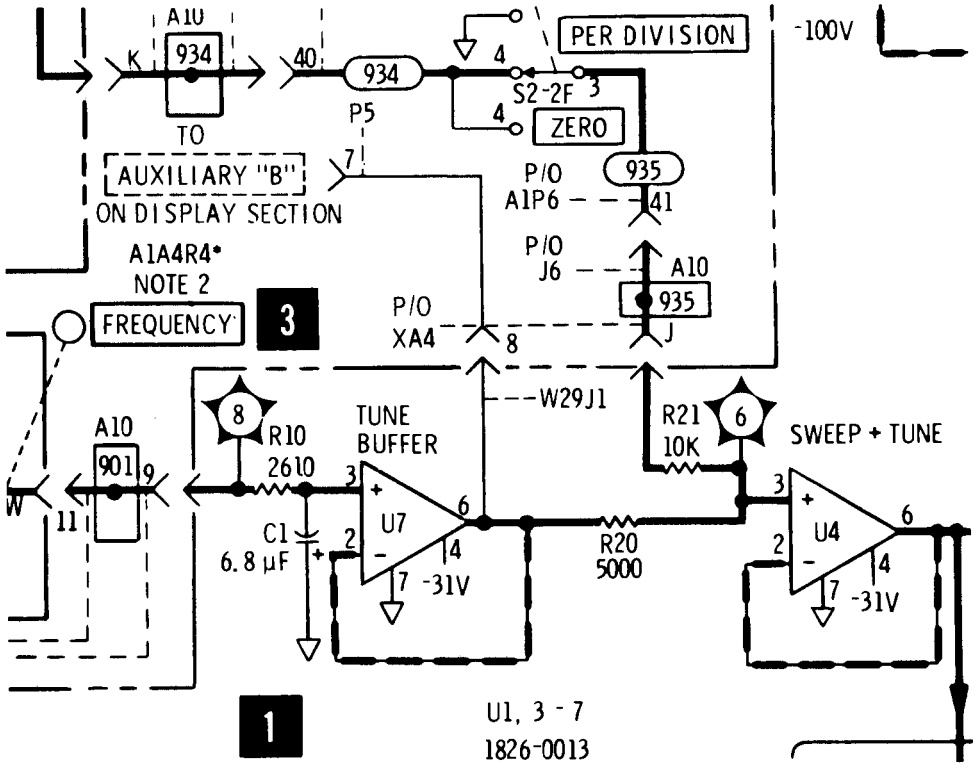


Figure B-3. Partial Schematic of Modified A4 Assembly

APPENDIX C

REFERENCES

DA Pam 310–4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7,8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310–7	US Army Equipment Index of Modification Work Orders.
TM 38–750	The Army Maintenance Management System (TAMMS).
TM740–90-1	Administrative Storage of Equipment.
TM 750–244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).
TM 11–6625-2781-24P-6	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tool List (Including Depot Maintenance Repair Parts and Special Tools) for Filter, Variable F-1414/U (HP Model 8445B) (NSN 6625–00–253–4833).

APPENDIX D

MAINTENANCE ALLOCATION

Section I INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for F– 1414/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards,

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement, Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul does not normally return an item to like new condition,

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment, The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components,

D-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Cagegory. Column 4

specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specivied by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/-quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C — Operator/Crew
O — Organizational
F — Direct Support
H — General Support
D – Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (See III)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. *Nomenclature.* This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. *Tool Number.* This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5–digit) in parentheses,

D-5. Remarks (See IV)

a. Reference Code, This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

SECTION II MAINTENANCE ALLOCATION CHART
FOR

FILTER, VARIABLE F-1414 /U (HP-8445B)

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	FILTER, VARIABLE F-1414 /U (HP-8445B)	Inspect	0.5					7	
		Test				0.3		1 thru 7	
		Service				0.4		1 thru 7	
		Align				0.7		1 thru 7	
		Adjust				0.7		1 thru 7	
		Install	0.3					7	
		Replace		0.3				7	
		Repair		0.2					A
		Repair				2.0		1 thru 7	
		Overhaul					24.0	1 thru 7	
01	CIRCUIT CARD ASSEMBLY, PREDRIVER, A1	Inspect				0.3		7	
		Adjust				0.3		1 thru 7	
		Replace					0.5	1 thru 7	
		Repair					1.0	1 thru 7	
02	CIRCUIT CARD ASSEMBLY, POWER SUPPLY, A2	Inspect				0.3		7	
		Adjust				0.4		1 thru 7	
		Replace				0.3		1 thru 7	
		Repair				1.0		1 thru 7	
03	CIRCUIT CARD ASSEMBLY, YIG DRIVER, A3	Inspect				0.3		7	
		Adjust				0.4		1 thru 7	
		Replace					0.3	1 thru 7	
		Repair					1.0	1 thru 7	
04	YIG FILTER, A4	Inspect				0.3		7	
		Replace					0.5	1 thru 7	
		Repair					1.0	1 thru 7	

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR

FILTER, VARIABLE F-1414/U (HP-8445B)

OOL OR TES EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	IATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H,D	TEST SET, METER TS-682/GSM-1	625-00-669-0747	
2	H,D	VOLTMETER, ELECTRONIC AN/URM-145	625-00-973-3986	
3	H,D	GENERATOR, SIGNAL AN/URM-127	625-00-783-5965	
4	H,D	OSCILLOSCOPE AN/USM-281C	625-00-106-9622	
5	H,D	TRANSISTOR TEST SET TS-1836C/U	625-00-159-2263	
6	H,D	MULTIMETER ME-26D/U	625-00-913-9781	
7	C,H,D	TOOLS AND TEST EQUIPMENT USED BY THE TECHNICIAN FOR THE ASSIGNED MISSION		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	REPAIR BY REPLACEMENT OF FUSE AND FRONT PANEL LAMP.

APPENDIX E

DIFFERENCE DATA SHEETS

The following changes must be made to the technical manual as a result of equipment production changes. Check the following table for the appropriate serial-number and enter any listed change(s) in the manual.

Serial Prefix or Number	Make Manual Changes
1442A00921 thru 1442A01175	1
1442A01176 thru 1442A prefix	1,2
1550A	1,2,3

CHANGE 1

Page 8-17, Figure 8-9, Service Sheet 2:
Replace with Figure 8-9A contained in this Manual Changes Supplement

Page 8.17, Figure 8-10, Service Sheet 2:
Add capacitor Cl, 2.2 µF from A1U1 pin 4 to signal ground (▽B). Show positive (+) side of capacitor connected to signal ground.
Add capacitor C2, 2.2 µF from A1U5 pin 7 to signal ground. Show positive (+) side of capacitor connected to pin 7.
Add capacitor C3, 2.2 µF from A1U5 pin 4 to signal ground. Show positive (+) side of capacitor connected to signet ground.
Add capacitor C4, 2.2 µF from A1U2 pin 7 to signal ground. Show positive (+) side of capacitor connected to pin 7.

Page 8.18, Figure 8-13, Service Sheet 3:
Replace with Figure 8-13A contained in this Manual Changes Supplement

Page 8-21, Figure 8-16, Service Sheet 4:
Replace with Figure 8-16A contained in this Manual Changes Supplement

Page 8-21, Figure 8-17, Service Sheet 4:
Add capacitor C4, 2.2 µF from A3U1 pin 4 to signal ground (▽B). Show positive (+) side of capacitor connected to signal ground.

Page 8.23, Figure 8-18, Service Sheet 5:
Replace with Figure 8-18A contained in this Manual Changes Supplement

Page 8.23, Figure 8-19, Service Sheet 5:
Add capacitor C7, 2.2 µF from A2U2 pin 7 to signal ground (▽B). Show positive (+) side of capacitor connected to pin 7.

Page 8-25, Figure 8-20, Service Sheet 6:
Replace with Figure 8-20A contained in this Manual Changes Supplement.

Page 8-25, Figure 8-21, Service Sheet 6:
Add A2R36 and A2C8 as shown in partial schematic Figure 1.

CHANGE1 (Cont'd)

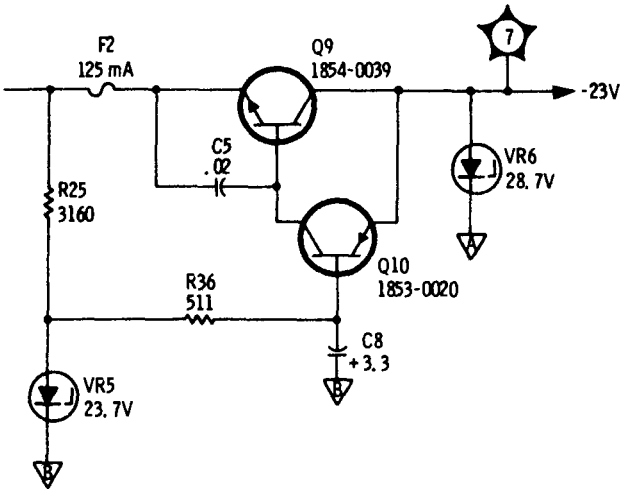


Figure 1. Partial Schematic of Figure 8-10(P/0 Change 1)

CHANGE 2 DELETED

CHANGE 3 DELETED

CHANGE 4

Page 8-17, Figure 8-10, Service Sheet 2:
Change part number of A1U1, U2, and U5 to 1826-0261 (preferred replacement).

Page 8-19, Figure 8-15, Service Sheet 3:
Change part number of A1U3, U4, and U6 to 1826-0261 (preferred replacement).

Page 8-21, Figure 8-17, Service Sheet 4:
Change part number of A3U1 to 1826-0261 (preferred replacement.

Page 8-23, Figure 8-19, Service Sheet 5:
Change part number of A2U2 and U3 to 1826-0261 (preferred replacement).

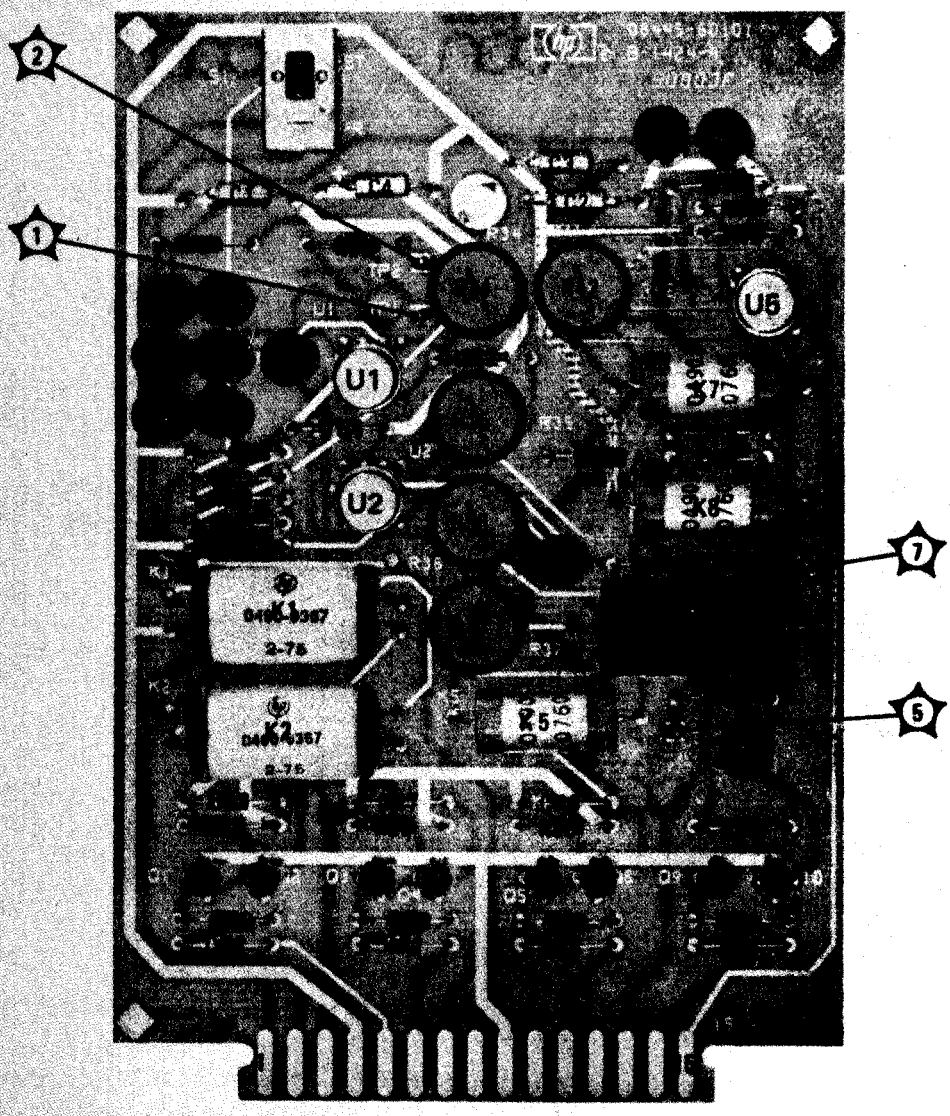


Figure 8-9A. A1 Predriver Assembly of 8445B (Except Option 003) (Change 1)

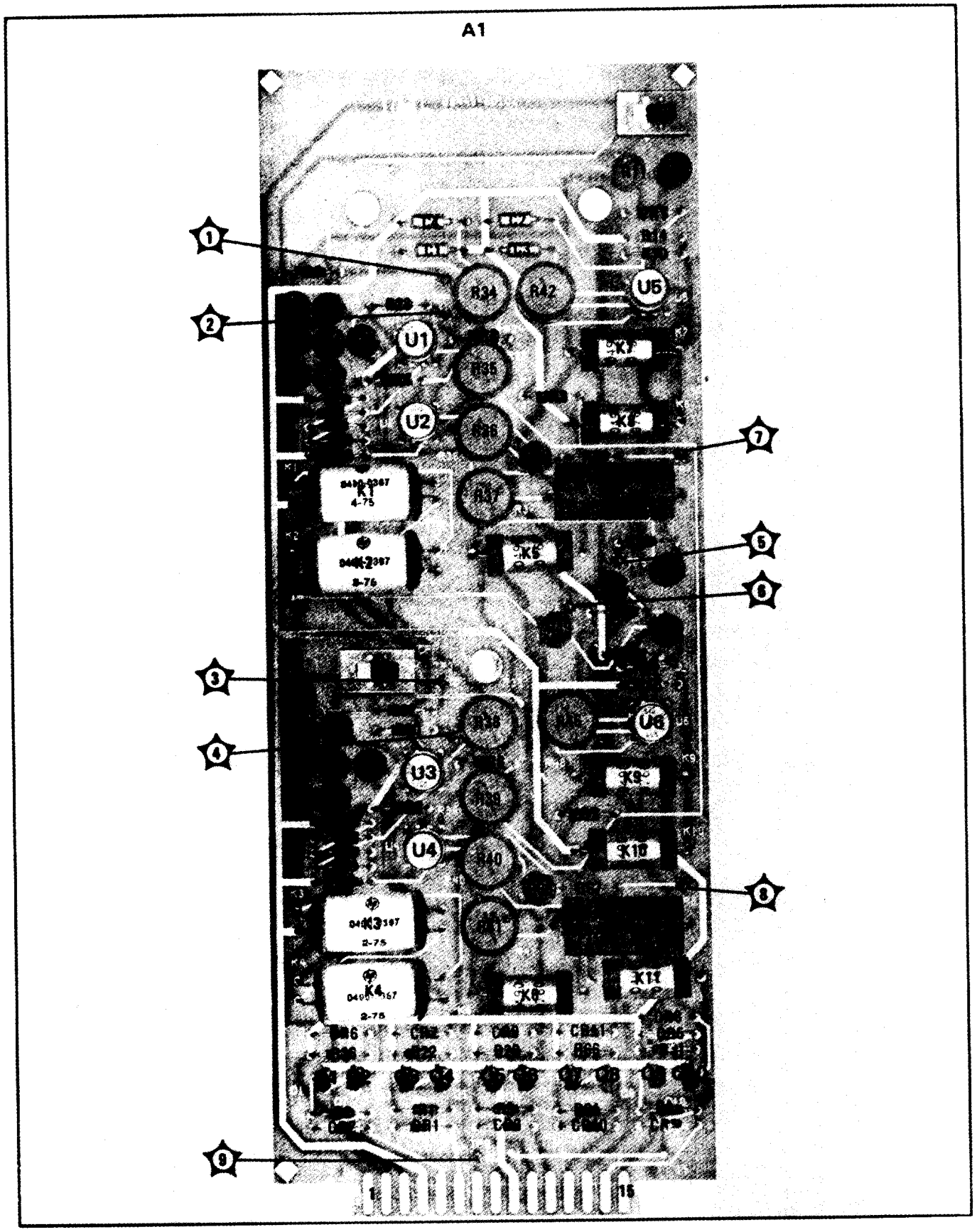


Figure 8-13A. A1 Predriver Assembly of 8445B (Option 003) (Change 1)

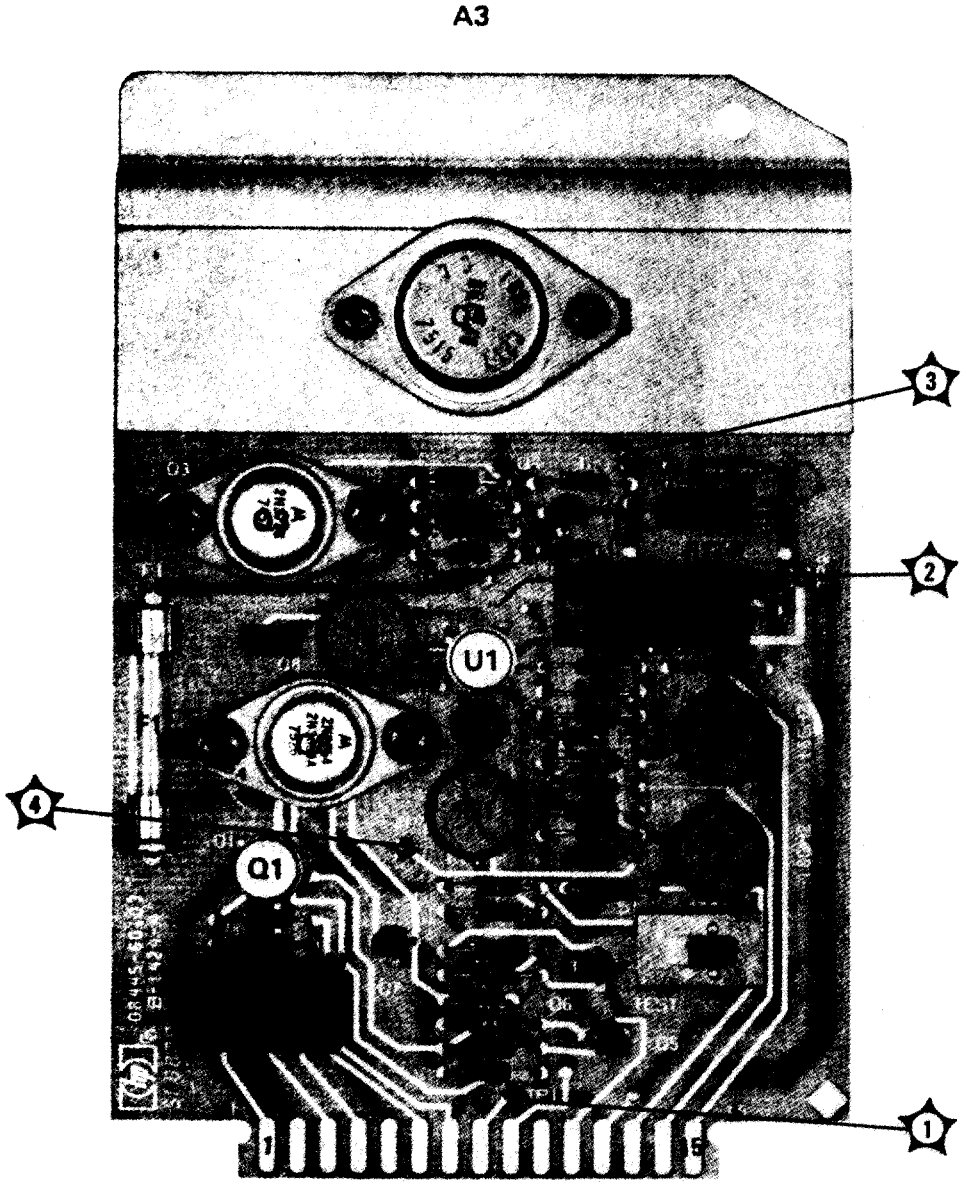


Figure 8-16A. A3 YIG Driver Assembly (Change 1)

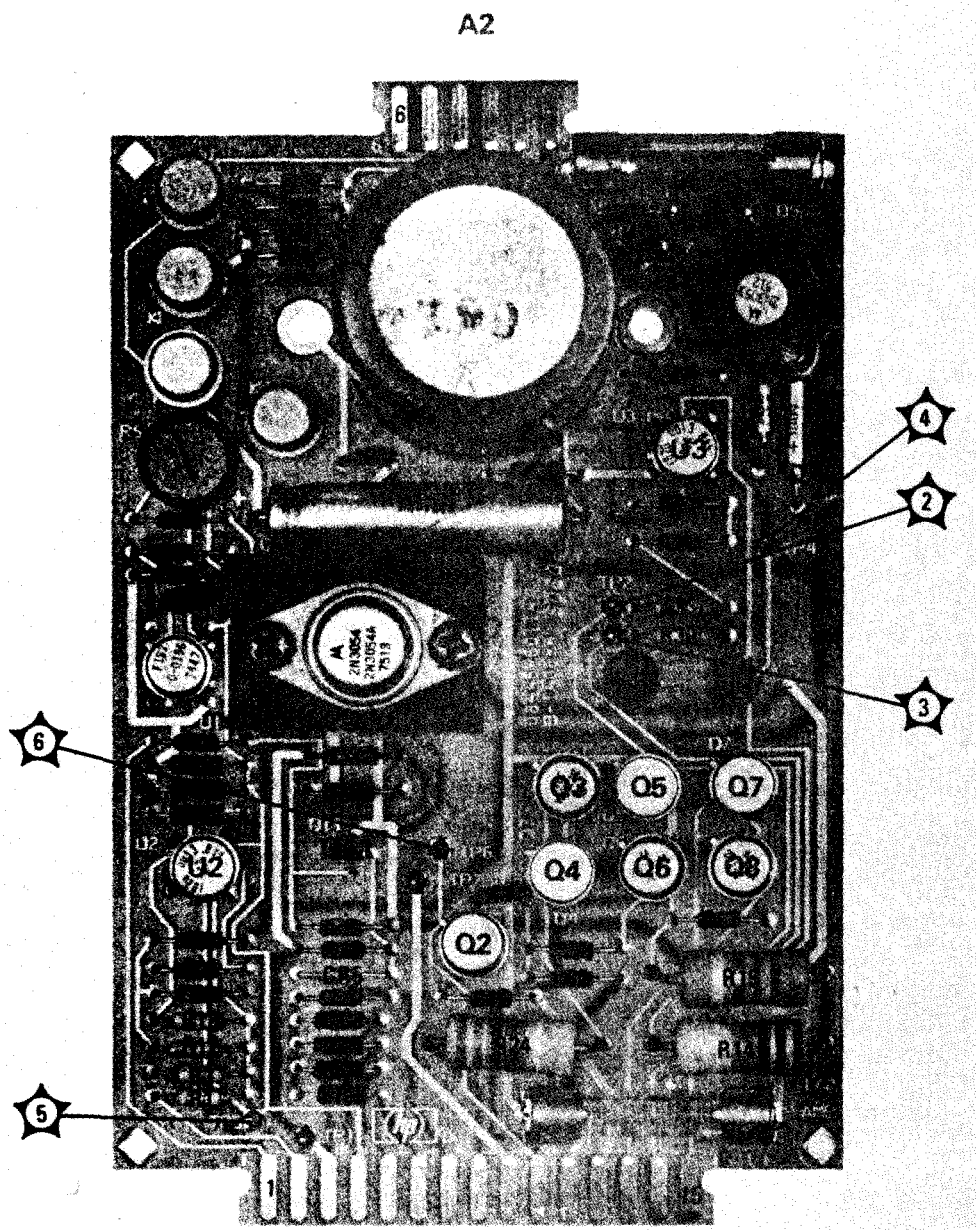


Figure 8-18A. A2 Power Supply Assembly, Remote and Manual Control Amplifiers/Switching Circuit (Change 1)

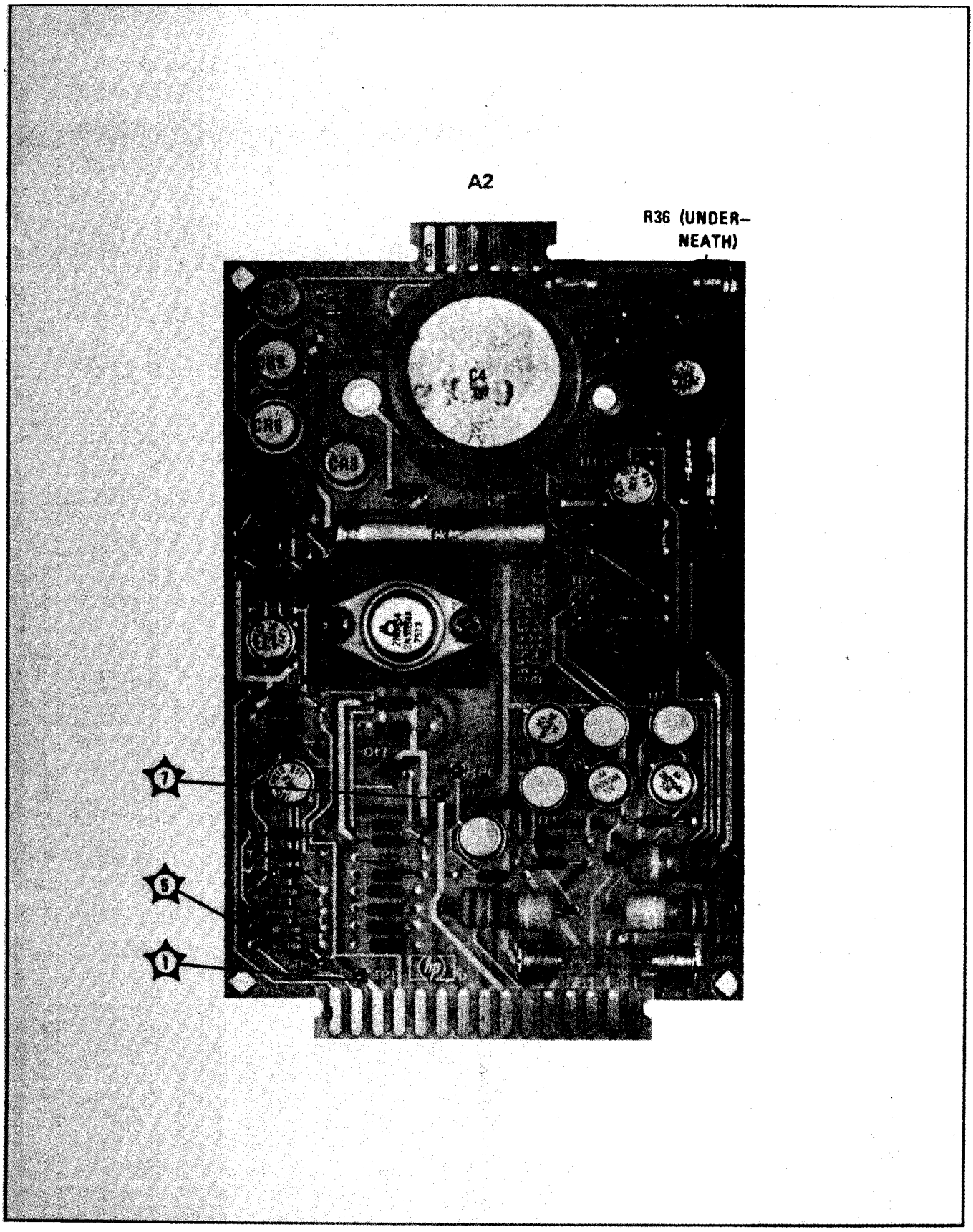


Figure 8-20A. A2 Power Supply Assembly, Supply Voltage Circuits (Change 1)

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TOAD (14)
SHAD (3)
USA Dep (1)
Sig Sec USA Dep (1)
Units org under fol TOE:
29–207 (2)
29–610 (2)

ARNG: NONE
USAR: NONE
For explanation of abbreviations used, see AR 310 – *50.*

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PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of [illegible] knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		F03		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
SSG I. M. DeSpiritof 999-1776

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THE METRIC SYSTEM AND EQUIVALENTS

NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

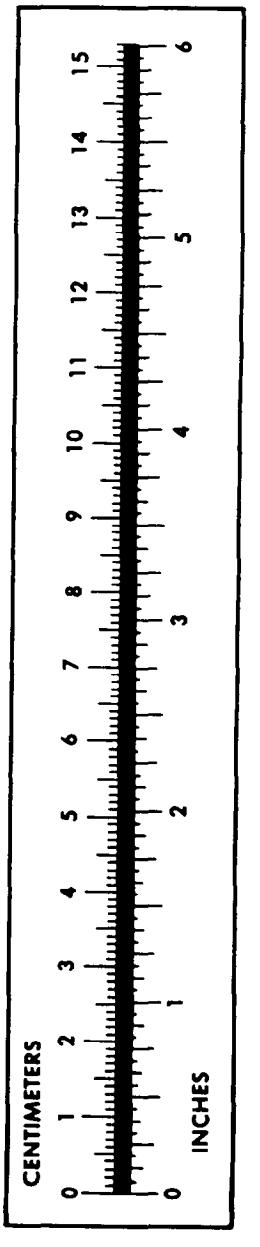
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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